

**Final Record of Decision
For the
Groundwater Control Operable Unit**

**Master Disposal Service Landfill Site
Town of Brookfield
Waukesha County, Wisconsin**



**United States Environmental Protection Agency
Region 5**

September 2007

EPA Region 5 Records Ctr.



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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
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CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF **SR-6J**

September 27, 2007

Mr. Thomas Wentland
Wisconsin Department of Natural Resources
Plymouth Service Center
1155 Pilgrim Parkway
Plymouth, Wisconsin 53073

**RE: Record of Decision for the Master Disposal Service Landfill Superfund Site,
Town of Brookfield, Wisconsin**

Dear Mr. ^{Tam}Wentland,

Attached please find two copies of the Record of Decision (ROD), signed September 26, 2007, for the Master Disposal Service Landfill (MDSL) Site. The ROD sets forth the Final Selected Remedy for the groundwater (Operable Unit 2), which is monitored natural attenuation with the contingency for groundwater extraction and treatment.

I appreciate your assistance in the selection of the Final Remedy and look forward to working with you during the remedial design and remedial action phases of this project. Copies of the ROD are also being sent to the town and city of Brookfield, the Brookfield Library Information Repository, the MDSL PRP Trust group, and STS Consultants.

Please contact me at the below-listed number if you have any questions or should you desire additional copies of the ROD.

Sincerely,

A handwritten signature in cursive script that reads "Sheila A. Sullivan".

Sheila A. Sullivan
Remedial Project Manager
U.S. EPA

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Acronyms and Abbreviations

| | |
|--------|--|
| AOC | Administrative Order by Consent |
| ARAR | Applicable, Relevant and Appropriate Requirement |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| AWQC | Ambient Water Quality Criteria |
| bgs | Below Ground Surface |
| CD | Consent Decree |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| CFR | Code of Federal Regulations |
| City | City of Brookfield |
| COC | Chemical/Contaminant of Concern |
| DCE | Dichloroethylene or Dichloroethene |
| EPA | United States Environmental Protection Agency |
| ES | Enforcement Standard (State of Wisconsin) |
| ESD | Explanation of Significant Differences |
| EW | Extraction Well |
| FR | Federal Register |
| FS | Feasibility Study |
| HDPE | High-Density Polyethylene |
| MCL | Maximum Contaminant Level |
| mg/L | Milligrams per Liter or ppm |
| MSL | Mean Sea Level |
| MW | Monitoring Well |
| NCP | National Contingency Plan |
| NPL | National Priorities List |
| NR | Natural Resources (as in "NR 140.28, WAC") |
| NRWQC | National Recommended Water Quality Criteria |
| O&M | Operation and Maintenance |
| ORC | Office of Regional Counsel (Region 5) |
| OSWER | Office of Solid Waste and Emergency Response |
| PALs | Preventive Action Limits |
| PCE | Perchloroethylene or Tetrachloroethylene |
| ppb | Parts per billion or ug/L (water) and ug/kg (soil/sediment) |
| ppm | Parts per million, or mg/L (water) or mg/kg (soil/sediment) |
| PRPs | Potentially Responsible Parties |
| RA | Remedial Action |

| | |
|--------|--|
| RAO | Remedial Action Objective |
| RCRA | Resource Conservation and Recovery Act of 1976 |
| RD | Remedial Design |
| RI | Remedial Investigation |
| ROD | Record of Decision |
| RP | Responding Party |
| RPM | Remedial Project Manager (U.S. EPA) |
| SARA | Superfund Amendments and Reauthorization Act of 1986 |
| SDWA | Safe Drinking Water Act |
| SEWRPC | Southeast Wisconsin Regional Planning Commission |
| SMCL | Secondary Maximum Contaminant Level |
| TBC | To Be Considered |
| TCE | Trichloroethylene |
| UAO | Unilateral Administrative Order |
| VOC | Volatile Organic Compound |
| WAC | Wisconsin Administrative Code |
| WDNR | Wisconsin Department of Natural Resources |

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Part I. Declaration for the Record of Decision

1. Site Name and Location

The Master Disposal Services Landfill Site is located in the town of Brookfield, Waukesha County, Wisconsin. The National Superfund Database identification number is WID980820070. The Site is divided into two operable units (OUs) to facilitate Site management. This Record of Decision describes the second operable unit which addresses the final groundwater remedy.

2. Statement of Basis and Purpose

This decision document presents the Final Selected Remedy for the Master Disposal Services Landfill (MDSL) Site, in the town of Brookfield, Wisconsin. The remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 United States Code §9601 *et seq.*, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300, as amended.

This decision is based on the Administrative Record for the Site, which has been developed in accordance with Section 113(k) of CERCLA, 42 United States Code §9613(k). This Administrative Record file is available for review by the public at the Brookfield Public Library, 1900 N. Calhoun Road, Brookfield, Wisconsin, and at the U.S. Environmental Protection Agency (EPA Region 5) Records Center in Chicago, Illinois. The Administrative Record Index (Appendix A) identifies each of the items comprising the Administrative Record upon which the selection of this Remedial Action is based. The State of Wisconsin concurs with the Selected Remedy.

3. Assessment of the Site

The response action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

4. Description of the Selected Remedy

Since the MDSL Site is located within an environmentally significant wetland, the environmental problems involving water balance were complicated. Groundwater was believed to be in direct contact with the waste materials and needed to be contained so that the contaminant plume would not spread. As a result, EPA declared in its first ROD for the Site, signed in 1990, that the work would be organized into two distinct operable units.

The first operable unit (OU1)-- a Source Control Operable Unit -- was specifically addressed in the 1990 ROD. This OU called for containing the waste mass by building a cap on the Site to prevent infiltration of water through the landfill; installing a groundwater extraction and treatment system to remove contamination from the shallower aquifers; monitoring the groundwater and surface water hydrology and wetlands to assess the quality and quantity of area groundwater, surface water and wetlands; and imposing site access restrictions and institutional controls including deed, land-use, and groundwater-use restrictions. By implementing an interim groundwater remedy under OU1 and deferring the final groundwater remedy, to be known as OU2, until a later time allowed EPA a chance to evaluate the effects of the source control groundwater extraction measures on the surrounding wetlands.

The Selected Remedy set forth in this ROD fulfills and completes the goals of the 1990 ROD. An interim source control remedy was implemented at the Site and has been operating since 1997. The interim remedy has already addressed contaminated soil, surface water, sediment, landfill gas, and groundwater to a large degree. The interim groundwater treatment system was discontinued in October 2003 after EPA approved a probationary shutdown period. Natural attenuation of the groundwater contaminants has been allowed to occur since that time.

The components of the Selected Remedy are described in detail in Section 19 of this ROD. Briefly, the major components of the Selected Remedy are:

- The groundwater would be allowed to clean itself up through monitored natural attenuation (MNA). A critical component of natural attenuation is the monitoring of groundwater at certain locations at the Site boundary and downgradient of the landfill to ensure that contaminants do not move off-site via the groundwater.
- Groundwater cleanup levels consistent with state and federal ARARs will also be established. Compliance with the chemical-specific groundwater cleanup levels in groundwater is determined beyond the edge of the Site boundary but within the Design Management Zone (DMZ) of the landfill; these levels do not have to be met throughout the landfill.
- This remedy includes the contingency that if monitoring indicates a potential failure of the Selected Remedy (i.e., triggering criteria are exceeded) signaling that benzene or other contaminants may exceed the cleanup levels beyond the DMZ boundary, a localized portion of the on-site groundwater extraction system will be reactivated to pull back the contaminated groundwater.

In addition, the final ROD for OU2 will clarify any unaddressed Site issues or minor modifications made to the remedy since the 1990 ROD. This includes memorializing the groundwater treatment to reflect that groundwater was biodegraded in the passive aeration pond system on the western side of the landfill before it was discharged to the drainage creeks that feed the Fox River system. Treated groundwater meeting WDNR discharge standards was allowed to

seep from the on-site pond through wetlands adjacent to the Site before discharging to the Fox River. There are no principal threat wastes for this operable unit.

5. Statutory Determinations

The final groundwater Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action (unless justified by a waiver), is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

The final remedy does not meet the statutory preference for treatment as per the NCP because source materials constituting principal threats have already been mitigated at the Site. The currently operating source control operable unit (OU1) selected in the 1990 interim ROD has effectively reduced the toxicity, mobility, and volume of hazardous substances, pollutants or contaminants as a principal threat at the Site. The landfill cap has successfully minimized further leaching of the chemicals of concern (COCs) from the source area into the groundwater. Maintenance of the cap is necessary to facilitate natural attenuation. The existing groundwater extraction and treatment system has been removing and treating contaminants that entered the groundwater prior to implementation of OU1. This final groundwater operable unit (OU2) will continue to treat contaminants through the use of monitored natural attenuation in order to break down hazardous substances and contaminants in the groundwater, thereby reducing the toxicity and volume of contamination. This will achieve the same beneficial results that an engineered treatment system would accomplish. Further, the Selected Remedy employs a contingency remedy. The contingency remedy calls for reactivating the onsite groundwater extraction and treatment system should MNA be found ineffective.

This remedy is the second operable unit remedy for the Site. The first operable unit (OU1) remedy resulted in hazardous substances, pollutants or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. As a result, a statutory five-year review of the Site was initiated in 2000 and will take place every subsequent five years to ensure that the OU1 remedy is, or will be, protective of human health and the environment. The second operable unit remedy in this decision document will also be reviewed in these five-year reviews until the remedy groundwater cleanup goals are met.

6. ROD Data Certification Checklist

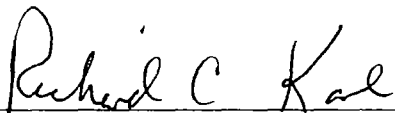
The following information is included in the Decision Summary (Part 2) of this ROD, while additional information can be found in the Administrative Record file for this Site:

- COCs and their respective concentrations (see Section 12.7-Groundwater Quality Evaluations, and Table 4);

- Baseline risk represented by the COCs (see Sections 9.5-Site Risks and 14- Summary of Current Site Risks);
- Remediation goals (i.e., cleanup goals) established for the COCs and the basis for the goals (see Section 15.0-Remedial Action Goals for OU2 and Table 4);
- How source materials constituting principal threats are addressed (see Section 18.0-Principal Threat Waste);
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of ground water used in the Baseline Human Health Risk Assessment and this ROD (see Sections 9.5-Site Risks, and 14-Summary of Current Site Risks);
- Potential land and ground water use that will be available at the Site as a result of the Selected Remedy (see Sections 13.1-Water Resources and Use, 13.2-Land Resources and Use, and 19.1-Expected Outcome of Selected Remedy);
- Estimated capital, lifetime operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected (Section 16.1-Common Elements and Features of Each Alternative); and
- Key factor(s) that led to selecting the remedy (see Section 19.0-Selected Remedy).

7. Authorizing Signature

This ROD documents the Final Selected Remedy for contaminated groundwater at the MDSL Superfund Site. The EPA selected this remedy with the concurrence of the WDNR (Appendix B –WDNR Concurrence with the Selected Remedy). The Director of the EPA, Region 5 Superfund Division has been delegated the authority to approve and sign this ROD.



Richard C. Karl, Director
Superfund Division

9.26.07

Date

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FINAL RECORD OF DECISION

ROD SUMMARY
Groundwater Control Operable Unit
Master Disposal Service Landfill
Town of Brookfield, Wisconsin

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Part II. The Decision Summary

This Decision Summary provides a description of the site-specific factors and analyses that led to the selection of the groundwater remedies for the Site. It includes background information about the Site, the nature and extent of contamination found at the Site, the assessment of human health and environmental risks posed by the contaminants at the Site, and the identification and evaluation of remedial action alternatives for the Site.

8.0 Site Name, Location and Description

8.1 Physical Characteristics

The Master Disposal Service Landfill (MDSL) Site is an inactive industrial landfill located at 19980 West Capitol Drive (Wisconsin Route 190) in the town of Brookfield, Waukesha County, Wisconsin (see Figure 1). The property is situated in the southwest quarter of Section 5, Township 7 North, Range 20 East of the Waukesha Quadrangle, Wisconsin. The Site occupies a 40-acre parcel of land, of which 26 acres comprise a presently inoperative landfill.

The Site lies in the marshy flood plain of the Fox River and is bounded by Wisconsin Route 190 to the south, and otherwise is surrounded by privately owned parcels of marshy wetlands and drainage channels. The flood plain has a relatively flat topographic relief with surface elevations ranging from 821 feet to 825 feet Mean Sea Level (MSL). The past landfilling operations at the Site have created a raised plateau, confined by perimeter berms, that is surrounded by the flat-lying lowlands. The Fox River, which flows into Illinois, is located about 300 feet west of the Site. The city of Brookfield, a western suburb of the city of Milwaukee, is about three-quarters of one mile east of the Site. The Site overlies a surficial sand/gravel and dolomite aquifer system, which was contaminated by on-site disposal activities. Groundwater at the Site flows primarily to the south-southwest toward the Fox River.

The Site sits near the northwest corner of the city of Brookfield. The land use in this area is currently semi-rural, mixed-use land and includes commercial, residential, and light industrial uses. The Site is immediately surrounded by a conservancy area with abundant wetlands and drainage areas for the Fox River and Sussex Creek. These wetlands comprise the majority of land around the Site and fall within the 10-year flood line. Hence, it is unlikely that any future development could occur within this vicinity of the landfill.

The remedial action is being conducted under the oversight of United States Environmental Protection Agency (U.S. EPA or EPA) as the lead agency and the Wisconsin Department of Natural Resources (WDNR) as the support agency. The source of the cleanup monies is a Consent Decree with the settling parties. The National Superfund Database identification number is WID980820070.

9.0 Site History and Enforcement Activities

This section of the ROD provides the history of the Site and a brief discussion of the EPA and the State of Wisconsin remedial and enforcement activities.

9.1 History of Site Activities

In late 1966, the Site was purchased by Master Disposal, Inc. and began its operation as the Master Disposal Services Landfill (MDSL). During the active life of the landfill (1967-1982), industrial and non-industrial solid wastes and drummed liquids were disposed on-site.

9.2 WDNR Enforcement Activities

In April 1967, after the WDNR received legislative authority to regulate solid waste facilities, WDNR inspected the MDSL Site and found that the Site was located entirely in a swampy, peat area. The WDNR subsequently advised Master Disposal, Inc. to delineate the floodplain and to maintain adequate diking around the Site. The WDNR chose not to license the Site due to its poor setting, but routinely inspected the Site during its years of operation.

The acceptance of hazardous materials at the Site was reported by the WDNR in April, 1970. The WDNR subsequently requested that waste characterization and groundwater information be submitted for evaluation.

A WDNR inspection in August 1973 indicated that the on-site operations consisted primarily of industrial waste disposal. Foundry sands and slags were the largest class of wastes accepted for disposal. Some evidence of hazardous waste (including solvents, paints, adhesives, oils, sludges and other industrial compounds) reportedly was present at the Site.

The WDNR performed approximately 19 inspections of the MDSL Site between December 1976 and August 1977. The inspections generally consisted of visual observations of disposal operations in the industrial waste disposal area, wood burning area, refuse disposal area, and salvage area. Most WDNR inspection reports noted that hazardous substances were being accepted. A summary report of the WDNR Site inspections noted that operational violations included: continuous open burning, inadequate waste covering, lack of surface water drainage, some acceptance of hazardous wastes, and deposition of waste materials directly into ponded waters.

In June 1977, Warzyn Engineering, Inc., under contract to the Site owner, completed a study which assessed the hydrogeological and geotechnical feasibility of continued disposal operations at MDSL. Warzyn recommended a phased abandonment of the Site over time based on the poor site setting, potential increase of contaminants to ground and surface waters, lack of on-site borrow materials, and difficult operating conditions.

A report of the hydrogeologic character of the Site was completed by WDNr in July 1977 and concluded that the groundwater and surface water quality beneath and downgradient of the landfill had been significantly degraded. In August 1977, the WDNr and the state Department of Justice entered into a stipulated agreement with Master Disposal Corporation. As a result, a state license was issued; however, the agreement called for Site abandonment within 2-1/2 years as well as the development of a groundwater monitoring program at the Site.

The owner/operator attempted to cap the landfill in 1982; however, the cover materials used at that time eroded, re-exposing the waste materials. The only known wastes that were received after the 1982 closure were wood wastes that were burned in the air curtain destructor; the ash from the burning was disposed on-site. By August 1984, the Site was covered with a two-foot thick cover and half of the Site was covered with topsoil. The owner ceased activity and closed the MDSL in 1985.

9.3 CERCLA Enforcement Activities

EPA and WDNr estimate about 1.4 million cubic yards of waste were disposed of at the Site between 1967 and 1982. The non-industrial waste consisted of general debris including service station waste, plastic, metal, paper, wood, tires, construction material, and miscellaneous garbage. The depths of the waste within the landfill varied from 10 to 25 feet.

On September 21, 1984, EPA placed the Site on the National Priorities List (NPL). Due to the Site setting, operational history and groundwater data, the Site was ranked in Group 4 of the NPL (40 CFR Part 300, Appendix B). The "Proposed Rule" proposing the Site to the National Priorities List (NPL) was published in the *Federal Register* on September 8, 1983. The "Final Rule" adding the Site to the NPL was published in the *Federal Register* on September 21, 1984. In 1985, EPA sent notice letters to potentially responsible parties (PRPs) informing them of an opportunity to engage in negotiations with the agency over the need to evaluate the extent of contamination at the MDSL Site. In June 1986, approximately 20 PRPs entered into an administrative order on consent (AOC) with EPA and WDNr for performing a Remedial Investigation and Feasibility Study (RI/FS). The goal of the RI/FS was to determine the effect of the MDSL Site on the surrounding environment and to present cleanup alternatives for reducing the risks to human health and the environment.

9.4 Remedial Investigation and Feasibility Study for OU1

The geology and hydrogeology at the Site were investigated during the RI (MDSL Remedial Investigation Report, prepared by The Earth Technology Corporation for Rollins Environmental Services, October 1989 on behalf of the settling PRPs).

During the RI, samples were taken from surface and subsurface soils, groundwater monitoring wells, residential and municipal wells, surface water, and sediment. Limited air and soil sampling were also performed. The primary contaminants or chemicals of concern (COCs)

affecting the soil and groundwater were organic compounds, inorganics compounds, and metals. Specifically, the primary COCs, several of which are carcinogens, were identified as:

| <u>Inorganic</u> | <u>Organic</u> |
|------------------|---------------------------------|
| Arsenic | Methylene Chloride |
| Cadmium | 1, 1-Dichloroethylene (1,1-DCE) |
| Chromium | Trichloroethylene (TCE) |
| Copper | Benzene |
| Lead | Toluene |
| | Xylenes |

Eighteen monitoring wells were installed at nine locations around the MDSL Site. Six wells were set in each of the following depths: shallow (A1 zone wells), intermediate (A2 zone wells) and deep (A3 zone wells). Groundwater samples were collected from the eighteen monitoring wells, five existing monitoring wells, seven residential wells and two municipal wells. The results of the groundwater monitoring showed elevated concentrations of both organic and inorganic compounds in both the sand/gravel and the dolomite aquifers. The RI described groundwater movement as being generally to the south-southwest toward the Fox River, and noted that there were residential well users located approximately one to two miles downgradient of the Site, however no Site contamination was found in the seven residential and two municipal wells sampled. Modeling showed that over a 70-year period, the plume of contamination could move as much as 1,500 feet south of the MDSL Site.

During the RI, the Fox River, dredge pond, and drainage channels surrounding the landfill were sampled twice to see whether site-related contaminants were present. A comparison of upstream river and drainage channel results to downstream locations showed that the Site has affected the surface water quality.

9.5 Site Risks Assessed During OU1

A baseline risk assessment estimates what risks the Site poses to human health and the environment if no remedial action was taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. A baseline risk assessment (or endangerment assessment) was completed for the MDSL Site in November 1989 by Earth Technology Corporation on behalf of Rollins Environmental Services for the settling parties under the CD to perform the RI/FS. The risk assessment concluded that the Site would pose a risk to human health if groundwater was consumed. The risk assessment considered both soil ingestion and skin contact for the adult populations, but did not take into account the use of the Site by children, as the Site was partially fenced. Dirt bike tracks were found at the Site during subsequent site visits, indicating that children may have gained access to the Site.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a Hazard Quotient (HQ). An $HQ < 1$ indicates that a receptor's dose of a single contaminant is less than the RfD, and that the toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An $HI < 1$ indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An $HI > 1$ indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI/RfD}$$

where:

CDI = Chronic daily intake

RfD = Reference dose.

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

The reasonable worst case HI at the MDSL Site was calculated to be 1.2 for adults due to ingestion of groundwater, based primarily on the contributions from lead, cadmium, and 1,1-DCE. The reasonable worst case HI calculated for children at the Site was 4.0, also attributed to groundwater ingestion.

For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

where: Risk = a unitless probability (e.g., 2×10^{-5}) of an individual's developing cancer
 CDI = chronic daily intake averaged over 70 years (mg/kg-day)
 SF = slope factor, expressed as $(\text{mg/kg/day})^{-1}$

These risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in

addition to the cancer risk individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site-related exposures is 10^{-4} to 10^{-6} .

At the MDSL Site, the cumulative carcinogenic risks for adults and children from the contaminant levels found at the Site were calculated to be 4×10^{-4} (four in ten-thousand) for adults and 1×10^{-3} for children. These risks were similarly due to ingestion of contaminated groundwater, and driven by the contaminants 1,1-DCE and benzene.

When the RI/FS was completed in July 1990, EPA had determined that the Site posed unacceptable risks to human health due to the threat of: 1) direct contact exposure to surface soil contamination; and 2) exposure to contaminated groundwater that served as a potential source of drinking water.

9.6 Objectives of the 1990 Source Control Remedy

The chief exposure pathways at the Site were direct contact with the waste mass and ingestion of groundwater. The selected remedy addressed these threats by containing the plume of contaminated groundwater, and by halting deterioration of existing cover materials which could result in further exposure of the waste mass. Waste materials in contact with the groundwater would continue to impact the groundwater; thus, groundwater containment was a necessary part of the source control alternative.

The overall intent of the RA selected in the 1990 ROD was to contain the groundwater plume. The presence of the surrounding, environmentally significant wetlands posed a problem in that an overly aggressive groundwater restoration effort could dry out and destroy these wetlands. Thus, the RA's primary focus was to control the landfill source and any portions of the contaminated groundwater that were possibly in direct contact with the landfill materials.

9.7 Source Control (Interim) Operable Unit (OU1)

At the conclusion of the RI/FS in September 1990, EPA, in consultation with WDNR, announced a Preferred Alternative. Since the environmental problems involving water balance were complicated, EPA organized the work into two distinct operable units (OUs).

The first operable unit (OU1), a Source Control Operable Unit, called for containing the waste mass by building a cap on the Site to prevent infiltration of water through the landfill. OU1 was an interim groundwater remedy. As such, meeting the federal and state groundwater quality levels was not a goal of OU1; hence, groundwater cleanup levels were not set forth in the OU1 ROD. The final groundwater remedy was deferred until the present time. This has allowed EPA a chance to evaluate the effects of the source control groundwater extraction measures on the surrounding wetlands and to establish appropriate groundwater cleanup criteria and a restoration

timeframe. The purpose of the final groundwater OU is to define the groundwater remediation standards and to select a final remedy for addressing contaminated groundwater at the Site.

The major components of OU1 were:

- Placement of a clay/soil cap over the fill material to prevent direct contact with landfill contaminants and to reduce infiltration into the waste mass. The cap was constructed in accordance with NR 504.07 and NR 506.08 Wisconsin Administrative Code¹ (WAC) and included an active landfill gas venting system to control landfill gas in order to meet air regulations;
- Installation of a groundwater extraction and treatment system to remove both organic and inorganic contamination from the sand and gravel aquifer unit (A1 and A2 zones) beneath the Site. The groundwater would meet the effluent limitations established by WDNR pursuant to its National Pollution Discharge Elimination System (NPDES) authority before being discharged from the treatment pond to the drainage areas feeding the Fox River;
- Monitoring of groundwater and surface water hydrology and wetlands to assess the quality and quantity (water budget) of area groundwater, surface water and wetlands. This would determine if further action would be necessary and if any adverse impacts to the wetlands would result; and
- Impose site access restrictions such as fencing; and institutional controls including deed, land-use, and groundwater-use restrictions.

9.8 OU1 Remedy Implementation

On January 30, 1992, a Consent Decree² (CD) between EPA and the PRPs to complete the Remedial Design and Remedial Action (RD/RA) for OU1 was signed. The PRP contractor, CH2M HILL conducted subsequent field investigations in October 1992 and August 1993 before implementing the approved RA. The Site capping, fencing, sign placement and landfill gas

¹ The Master Disposal Site received primarily industrial wastes of a non-hazardous nature. While such wastes contain hazardous substances, they are not RCRA hazardous wastes, and waste mass (landfill) contamination is at relatively low levels. Therefore, the selected remedy for the Site included a clay/soil cap over the waste mass with active gas venting and groundwater pump and treat systems to contain and treat groundwater as well as to prevent contaminants from leaving the Site in the shallow alluvium aquifer. In accordance with NR 504.07 and NR 506.08 Wisconsin Administrative Code, the cap system is composed of a minimum 2-foot thick clay cap to minimize water from infiltrating through the landfill; covered by a 1½ to 2 ½-foot thick soil frost-protection layer; covered by a layer of top soil at least 6 inches thick to promote vegetation growth. The cap is sloped to allow water runoff. An active venting system, complying with Wisconsin NR 504.05, was installed to reduce gas buildup from decomposition in the landfill and to monitor/control gas emissions.

² United States of America and the State of Wisconsin v. Brake, Clutch and Drum, et al. U.S. District Court, E.D., Wisconsin 1992.

venting were completed in October 1994. The design plans for the source control groundwater extraction and treatment system were approved on July 29, 1996. Construction of the groundwater extraction system was finished by the end of 1997. The groundwater extraction system consists of 11 extraction wells from which contaminated groundwater is pumped and discharged to the large pond on the western side of the Site (see Figure 2). The extraction well network capacity was designed to withdraw about 85 gallons-per-minute (gpm) of contaminated groundwater for treatment. The pumping rate was estimated based on a well performance test conducted in July of 1994. The rate of pumping for each well can be varied during operation.

The 1990 ROD determined that treatment of the extracted groundwater would be achieved using one of four potential treatment technologies identified, i.e., air stripping, carbon adsorption, ion exchange, or chemical treatment. The ROD allowed the treatment technology to be selected during the remedial design (RD) stage, at which time treatment-specific data would be collected for groundwater. The RD studies determined that the groundwater contained significant levels of Biochemical Oxygen Demand (BOD) and ammonia for which the Best Available Technology Economically Achievable (BATEA) was determined to be biological treatment via an aerobic stabilization pond. Consequently, groundwater treatment includes biodegradation in a passive aeration pond system before discharge to the drainage creeks that feed the Fox River system. The groundwater treatment remedy, as implemented, differed from the four potential treatment options put forth in the 1990 ROD. This final ROD for OU2 memorializes this change.

Treated groundwater meets WDNR standards for discharge to the Fox River. Treated waters are allowed to seep from the on-site pond through wetlands adjacent to the Site before discharging to the Fox River. If the discharge had been routed directly into the Fox River, the wetlands would have suffered a net loss of water. As specified in EPA-approved design reports, the extraction system typically shuts down from November through March, when pond water temperatures are too low for natural biodegradation to occur. The groundwater moves at a slow enough rate that contaminants remain under the system's influence even when the system is shut down during this time period.

9.8.1 Required Monitoring Under OU1

A comprehensive Site monitoring plan was finalized in July 1996 and was divided into the following three modules:

Module 1: Groundwater and Wetlands Monitoring Program consists of three components:

1) Quarterly containment monitoring of six piezometers and 11 extraction wells evaluates groundwater elevations between the landfill and the pond. These elevations and hydraulic gradients are used to determine the effectiveness of the groundwater capture and extraction system in preventing further migration of groundwater contaminants in the A1 and A2 zones.

2) Quarterly groundwater samples are collected from the A3 zone to characterize potential contamination. Annual groundwater samples are collected from the A1 and A2 zones to characterize the nature and extent of groundwater contamination over time.

3) Annual vegetation surveys were conducted to detect potential hydrologic changes, vegetation stress, and species changes in the wetlands surrounding the Site.

Module 2: Extracted Groundwater and Surface Water Monitoring Program evaluates the water quality of discharges from the groundwater extraction system to the pond, and the acute toxicity and water quality of pond discharges to the wetlands.

These results are also used to demonstrate compliance with the substantive requirements of the Wisconsin Pollutant Discharge Elimination System (WPDES). Monthly pond surface water and quarterly bioassays of the pond were conducted. Effluent discharge limitations for treated groundwater were calculated from state discharge statutes, and specified weekly averages for metal contaminants and monthly averages for VOCs, as well as maximum concentration levels. These limitations were included in the 1990 ROD.

Module 3: Landfill Gas Monitoring Program identifies and quantifies primary constituents present in the landfill off-gas and the volume of the off-gas generated.

The landfill gas from the venting system was sampled to determine if the mass emission rates of several constituents in the landfill gases exceeded the regulatory levels found in the applicable provisions of the National Emission Standards for Hazardous Air Pollutants (NESHAP) and the more stringent WAC Chapter NR 445.

The 1992 CD required monthly reporting by the PRPs and the submission of a technical memo after the collection of data for two years following startup of the extraction system. At that point, the PRPs were allowed to petition for a reduction in the sample collection frequency. On May 6, 1999, the PRPs submitted a two-year evaluation technical memorandum which summarized results from the monitoring and recommended the following revisions to the monitoring regime:

1. Intensive piezometer water level monitoring should be performed in Spring during startup of the extraction system in order to distinguish the effects of the extraction system from natural shallow groundwater level fluctuations;
2. Monitor groundwater elevations at all on-site monitoring wells quarterly;
3. Groundwater quality monitoring of the shallow aquifer system (A1 and A2 zones) should be continued but reduce the A3 zone monitoring frequency from quarterly to annually;

4. Continued monitoring of pond surface water elevation and extracted groundwater and pond surface water quality. If acute toxicity bioassay results continue to be negative, the testing should be changed from quarterly to annually as of April 2000; however, the testing should occur in July after the system has been started up annually;
5. The landfill gas monitoring be discontinued after a year of quarterly sampling events showed no exceedances;
6. Discontinue the annual vegetation survey; the extraction system shows a negligible impact on groundwater levels in the surrounding wetlands and vegetation data do not argue for a change in remedial activities.

9.8.2 Monitoring Regime Changes for OU1

EPA, in consultation with WDNR, determined that reduced monitoring was appropriate for this Site in January 2000, based on the data collected. The landfill gas monitoring was eliminated. Thirty monitoring wells and 11 extraction wells continued to be monitored each quarter for water levels and 23 wells continued to be sampled annually for the COCs. In September 2000, EPA also approved the elimination of the annual vegetation survey from the monitoring program. These changes from the original monitoring program to the current schedule are depicted in Table 1.

Based on the relatively slow groundwater flow velocities and negligible changes in horizontal hydraulic gradients associated with the groundwater extraction system beneath most of the landfill area, the PRPs requested a probationary shutdown of the existing extraction system in May 2004. The PRPs provided the requisite technical justification to show that a shutdown would not modify the local hydrogeologic flow system to result in adverse impact to human health and the environment. The PRPs conducted post-shutdown groundwater monitoring for one year to document that no adverse impact to human health and the environment resulted from the shutdown. The groundwater extraction system was shut down from October 2003 through October 2004 at which time, a full year of post-shutdown groundwater data was collected.³ The groundwater extraction system, though currently not operating, remains on-site should it need to be operated.

9.8.3 Implementation of Institutional Controls (ICs) and Other Measures

EPA determined that the necessary ICs required to effectuate the OU1 RA and to protect public health and the environment consist of the following land use restrictions and conditions:

³ Although EPA approved the probationary shutdown of the groundwater extraction and treatment system in June 2004, the actual one-year probationary period was retroactively begun in October 2003. This enabled the already ongoing winter shut-down period (November-March) for that year to be included as part of the probationary period.

**TABLE 1 - MONITORING PLAN FOR THE MASTER DISPOSAL SERVICE
LANDFILL SITE**

| Module 1: Groundwater Sampling and Wetland Survey Schedule | | | |
|--|--|---|---|
| Sample Location | Analyses | Frequency | Purpose |
| Groundwater Monitoring | | | |
| EW-1-EW-11, PZ-01-PZ-06, B-01 | Water Levels | Monthly | Monitor fluctuations in groundwater elevations |
| PZ-02 | Benzene | Monthly - Collected since benzene was detected in June 2004 | Levels are monitored to assess the trend and stability of benzene |
| A1 Zone: PZ-01-PZ-06, E1-E11, B-5, B-31, OB-07S A2 Zone: B-49, B-50, OB-08I, OB-07I A3 Zone: B-46, B-48, B-56, B-51, OB-08D, OB-09D | Water Levels | Quarterly: January, April, July, October, | Monitor fluctuations in groundwater elevations along the southern edge of landfill to determine the effectiveness of the capture of contaminated groundwater; water levels in wetlands; hydraulic gradient control provided by pond |
| A1 Zone: OB-07S, OB-08D A2 Zone: OB-07I OB-08I A3 Zone: B-46, B-48, B-51, B-56, OB-08D, OB-09D | Field analyses; TCL and TAL; COCs; conventional analyses | Quarterly: April, July, October, January Frequency changed from quarterly to annually as of January 2000. | Determine the nature and extent of contamination in the A1 and A2 zones; determine whether contamination has or could potentially migrate to the A3 zone; and establish baseline groundwater quality for new wells. |
| A1 Zone: B-53, B-31, B-5, B-44, B-10, B-1, B-60, B-58, OB-07S A2 Zone: B-47, B-49, B-50, B-45, B-9, OB-7I, OB-08I A3 Zone: B-43 | Field Analyses, COCs, and conventional analyses | Annually: October | Monitor fluctuations in the groundwater elevations and changes in groundwater quality |
| Annual Wetland Survey | | | |
| T-2, T-3, T-4, T-6, T-8, T-10 | Monitor stress and changes in wetland vegetation | Annually: Late summer or early fall Discontinued as of September 2000 | Evaluate impact of potential groundwater drawdown on wetlands vegetation |

| Module 2: Process and Surface Water Sampling Schedule | | | |
|--|--|--|--|
| Pond Staff Gauge | Water level, field analyses, COCs, conventional analyses, discharge parameters | Monthly grab sample | Assess process/pond water quality |
| Extracted Groundwater Manifold Pipe and EW-11* | Field analyses, conventional parameters, COCs | Quarterly: April, July, October, January | Assess process influent water quality and process performance |
| Pond | Acute toxicity bioassay | Immediately following treatment system startup. One battery of tests per quarter for the first 3 years, afterward reduced to once/year. Discontinued in 2000 | Assess pond effluent water quality |
| Module 3: Landfill Gas Sampling Schedule (Module Discontinued as of January 2000) | | | |
| Landfill Offgas Vents: CTV-02, CTV-04, CTV-06, CTV-07, CTV-09, CTV-11, CTV-15 | NR 445 Table 3, Group A, nonpharmaceutical compounds, methane, and NMOCs | First quarter of one year (March) | Demonstrate landfill gas emissions of primary constituents do not exceed allowable regulatory levels |
| Landfill Offgas Vents: CTV-02, CTV-04, CTV-06, CTV-07, CTV-09, CTV-11, CTV-15 | Benzene, vinyl chloride, methane, non-methane organic compounds (NMOCs) | Second, third, and fourth quarter of one year: June, September, December | Demonstrate landfill gas emissions of primary constituents do not exceed allowable regulatory levels |

Note: Turquoise shading indicates those monitoring activities that have been discontinued; yellow shading indicates those monitoring activities that have been added or modified. All changes were reviewed and approved by EPA and WDNR.
 * This analysis is currently suspended during the probationary shutdown of the groundwater extraction system.
 PZ = Piezometers; E = Extraction wells; B, OB = Monitoring wells; T = Transect lines

- 1) No interference with construction, operation and maintenance (O&M), monitoring, and efficacy of any components or improvements resulting from the RA;
- 2) No extraction, consumption or other use of groundwater from beneath the Site, except for the work specified in the RA;
- 3) No agricultural, recreational, residential, commercial, or industrial use of the landfill cap area or other areas containing RA components. This includes excavation, grading, or other landfill capping operations and any construction of buildings, other than for the purpose of implementing the RA;
- 4) No construction, installation, or use of any buildings, wells, roads or structures on the facility property that could affect the physical integrity, O&M, or efficacy of the remedy.

The types of ICs that are typically imposed at an NPL site include governmental controls, proprietary controls, and information devices. The PRPs were to secure deed restrictions incorporating the preceding four land use restrictions. The restrictions were to run with the land and bind any persons acquiring title or any legal interest in the property. At present, there are no deed restrictions pertaining to the Site property on file at the Waukesha County Register of Deeds.

In December 1985, the name of the property owner was changed from Master Disposal, Inc. to Western Disposal, Inc. In September 1993 Western Disposal, Inc. was administratively dissolved. According to Waukesha County Geographic Information System (GIS) maps, the 40-acre parcel (of which 26 acres is occupied by the landfill) was titled to Master Disposal Inc. A 2005 title commitment indicated that the current deed record holder is Western Disposal Landfill, Inc. The PRPs could not place a deed restriction directly on the MDSL Site property because they do not own the property.

A subparcel of the property (about 0.61 acres) fronts West Capitol Drive and contains a 6,160 square-foot garage building that was erected in 1980. There are no known wells on this subparcel area and no water or sewer utility services. According to the current county GIS data, the subparcel is zoned T-1 or transitional use. This zoning category is used when the rural landscape is quickly changing in order to provide for the pacing and shaping of development. In this case, the town of Brookfield did not want to zone the land prematurely before EPA determined if the land use should be restricted. The surrounding parcels are classified as wetlands and are zoned as conservancy districts. Installation of groundwater wells on this subparcel could endanger human health due to its proximity to the groundwater contamination under the landfill. Pumping the groundwater could draw the contamination beyond the landfill under the subparcel. Therefore, installation of any well on this subparcel will be prohibited. The subparcel shall not be utilized in a way which adversely affects the remedial action anywhere else on the Site.

Site access controls are in place and consist of a continuous 6-foot high cyclone site perimeter fence and three locked and chained gates. The main gate is at the southeast corner of the property. Two other gates are located at the southwest and northwest corners of the landfill. The main gate is accessible from Capitol Drive.

At EPA's request, the PRPs have posted a larger sign with more visible and accurate information. Another information device involves the fact that the State of Wisconsin requires a variance from the state well construction standards for the installation of private wells within 1,200 feet of a landfill. Under this requirement, a licensed Wisconsin well driller must determine if a new well installation is within the 1,200-foot buffer zone. If the proposed area is within this zone, then the well driller would require special approval from the WDNR to install a well in this area.

Consistent with the state statute, if COC concentrations in groundwater exceed NR 140 Enforcement Standards, the Site will be put onto an Internet accessible database, called the GIS Registry of Closed Remediation Sites (GIS Registry), after a complete closure request is submitted by the PRPs to the WDNR and approved by WDNR. As of the 2001 rule revisions, the GIS Registry replaced the requirement for groundwater use restriction on properties with residual groundwater contamination exceeding the ES.

9.9 Remedial Action Performance

Based on a review of relevant documents, applicable or relevant and appropriate requirements (ARARs), risk assumptions, and the results of Site inspections, all portions of the ongoing source control remedy appear to be functioning as intended by the 1990 ROD and are expected to continue in this manner. The effectiveness and progress of the remedy has been tracked through the monitoring program. Site monitoring has been performed since October 1996. These data indicate that the Site presently does not pose an immediate threat to human health or the environment. However, if Site groundwater were to be used as a potable water source, then unacceptable risks would occur.

Vegetation surveys of wetland communities showed some changes in the composition and nature of wetland plant communities in the areas nearest the extraction wells. Fluctuations in water levels, which may be seasonal in nature, have been documented in several areas of the wetlands. However, because no overall adverse impacts to the wetlands and vegetation were documented, EPA approved the elimination of annual wetland surveys for the MDSL Site in September 2000.

10.0 Community Participation

As required by CERCLA and the NCP Section 300.430(f)(3), community relations activities have been conducted by EPA over the years for the source control operable unit (OU1) at the Site. EPA has also maintained an Administrative Record, which contains the legal documentation supporting EPA's cleanup proposals and decisions, and a Site information

repository in the community throughout the cleanup process at the Brookfield Library, 1900 N. Calhoun Road, Brookfield, Wisconsin. Site information and progress updates are also available to the public on EPA's Website in the form of NPL Fact Sheets and more recently, human exposure and groundwater migration control status. During the intervening years since the 1990 ROD was signed, there has been no community interest in the Site. In 2000 and 2005 respectively, EPA conducted its first and second five-year reviews at the Site during which site inspections, solicitation of public input and community interviews were held. During the 2005 five-year review, township officials were interviewed and reported that no Site-related community concerns have been raised.

With the announcement of the Proposed Plan for the final groundwater control operable unit (OU2) on July 12, 2007, a public comment period was held between July 12 and August 10, 2007. The Administrative Record, which houses the legal documentation supporting EPA's proposal was updated to include the newer materials for OU2. These materials were made available for review at the Brookfield Public Library. A copy was also at the EPA Region 5 Office in Chicago at the 7th Floor Record Center.

During the months leading up to EPA's announcement, the community interest in a public meeting was gauged to be low to nonexistent. Coordinating with the town of Brookfield, EPA posted its Proposed Plan announcement on the town's website where the public was encouraged to comment on any aspects of the final groundwater control remedy for the Site. Because of the lack of interest, EPA did not schedule a public meeting but indicated that a meeting would be held should any members of the public request one. No meeting was requested; however, EPA and WDNR attended an open monthly Brookfield Town Council meeting on July 17, 2007 and briefed the council and public attendees on the Site progress and the Preferred Remedy for the final groundwater remedy (OU2). A groundwater remedy display and various handouts were left at the Brookfield Town Hall for the residents. EPA has received one written comment during the public comment period, which is included in the Responsiveness Summary as part of this ROD.

11.0 Scope and Role of Final Groundwater Operable Unit (OU2)

The environmental setting at the MDSL Site has contributed to the complexity of the remediation. As a result, EPA organized the work into two operable units (OUs):

- Operable Unit 1: Contain the landfill source, i.e., the principal threat to human health and the environment at this Site, and any portions of the groundwater that may be in direct contact with the contaminated landfill materials. This was achieved by capping the landfill and controlling the extraction of groundwater so that contamination did not migrate beyond the Site boundary. The wetlands, which are hydrologically connected to the groundwater aquifers, were a major consideration of the RA because they could easily be destroyed if too much groundwater was pumped out of the aquifers in a short period of time. Over the six-and-one-half years that the controlled pumping has occurred, contaminant levels have declined in the groundwater and the wetlands have

remained viable.

- Operable Unit 2: Set groundwater clean-up levels that are consistent with state and federal ARARs, and restore the groundwater in both upper alluvium aquifer and underlying dolomite aquifers (A1, A2, and A3 zones) to these levels while minimizing impacts to the surrounding wetlands, the Fox River, and the environment.

In addition, this Final ROD for OU2 clarifies minor modifications made to the remedy since the 1990 ROD. This includes memorializing the groundwater treatment to reflect that groundwater was biodegraded in the passive aeration pond system on the western side of the landfill before it was discharged to the drainage creeks that feed the Fox River system. Treated groundwater meeting WDNR discharge standards was allowed to seep from the on-site pond through wetlands adjacent to the Site before discharging to the Fox River. Groundwater treatment was discontinued in October 2003, when the groundwater extraction system began its probationary shutdown period.

12.0 Site Characteristics

This section of the ROD provides an overview of the Site's geology and hydrogeology; the conceptual site model (CSM); and the current nature and extent of contamination at the Site. Detailed information about the Site characteristics can be found in the RI Report (Earth Tech. 1989).

12.1 Site Overview

The Master Disposal Service Landfill Site occupies a 40-acre parcel of land of which 26 acres comprise a presently inoperative landfill. The Site lies in the marshy flood plain of the Fox River and is bounded by Wisconsin Route 190 to the south, and otherwise is surrounded by privately owned parcels of wetlands and drainage channels. The Fox River, which flows into Illinois, is located about 300 feet west of the Site (see Figure 2). The landfilling operations at the Site have created a raised plateau, confined by perimeter berms, that is surrounded by flat-lying lowlands.

The Site lies within the area of influence of the National Weather Service meteorological observation station located in Waukesha, Wisconsin. Climatological data from this station have been used for average temperatures, precipitation, and snowfall. The mean annual temperature is 46.7 degrees Fahrenheit (°F), with monthly means ranging from a low of 18.1°F in January to a high of 71.8°F in July. Monthly maximum temperatures range from 26.0°F to 82.5°F, and monthly minimum temperatures range from 10.1°F to 61.1°F. The annual mean value for precipitation is 32.02 inches per year. Monthly means range from a minimum of 1.10 inches in February to a maximum of 3.79 inches in August. The annual mean snowfall for the area is 42.9 inches. Snowfall values range from a minimum of 0.1 inches in October to a maximum of 10.9 inches in January. Generally, there is no snowfall from May through September.

12.2 Wetlands

The Site lies within a primary environmental corridor. The Southeastern Wisconsin Regional Planning Commission (SEWRPC) defines those areas in southeast Wisconsin with the highest concentrations of natural, recreational, historic, and scenic resources as "environmental corridors." A primary environmental corridor is further defined as being at least 400 acres in size, two miles in length, and 200 feet in width. Resources contributing to the area's ranking as a primary environmental corridor include the Fox River, the wetlands, and wildlife habitat areas. SEWRPC recommends that designated primary environmental corridors in the southeastern Wisconsin region be preserved essentially for natural, open uses. If these corridors are preserved as recommended, then there is the likelihood that the corridor lands will continue to contribute to the maintenance of the ecological balance and natural beauty of the region.

During May, 1977, several seine hauls were conducted in the Fox River to determine what kinds of fish species inhabit the river at the Site location and to determine whether the same species of fish inhabited the river upstream as well as downstream of the Site. The results of the study indicated that there was no degradation or enrichment of the Fox River, in the vicinity of the landfill, which could affect aquatic organisms. A heron rookery has been observed over the years in the tree stand of the wetland parcel immediately east of the Site. Other wildlife in the area includes deer, rabbits, raccoons, squirrels, and other rodents, animals and birds. There are no known records of endangered or threatened animal or plant species in or surrounding the Site area. The diversity the fish and wildlife species on the Site and in the surrounding ecological corridor areas would only be expected to remain stable or improve since the implementation of OUI.

More recently, since the implementation of OUI, annual vegetation surveys of wetland communities occurred between 1996 and 1999. Some changes in plant community parameters, such as dominant species, have occurred during the survey period. In several areas of the wetlands, some fluctuation in water levels has been documented that may be seasonal in nature. In addition, the composition and nature of wetland plant communities have changed in several areas of the Site. In particular, wetland areas near the extraction wells are dominated by a dense cover of reed canary grass. This species is very aggressive and can dominate other wetland plants. Consequently, a shift towards a monotypic stand with lower plant diversity may be occurring in these areas of the Site. In contrast, in other areas, communities are more wooded and contain a greater diversity of ground cover species. In September 2000, EPA approved the elimination of annual wetland surveys for the MDSL Site.

The purpose of the 1996 wetland survey was to establish ambient wetland conditions in the absence of groundwater extraction, and the 1997-1999 wetland surveys were conducted to evaluate the effect of groundwater extraction on the wetlands. The probationary shutdown of the groundwater extraction system since October 2003 has allowed for a return of local groundwater elevations and hence wetland hydrology to ambient conditions. Completion of new wetland

vegetation surveys would be appropriate if the local hydrologic system is modified by renewed operation of the groundwater extraction system.

12.3 Site Hydrology

The Site is located in the marshy floodplain of the Fox River and is partially surrounded by man-made drainage channels leading to the river. The landfill occupies approximately 26 acres of a 40-acre land parcel. Landfilling operations and the subsequent installation of the five-foot thick landfill cap, under OU1 have created a sloped plateau. The slopes on top of the closed landfill are at least three percent. The side slopes are 25 percent (1 vertical: 4 horizontal) except along the east edge where the slope is 50 percent (1 vertical:2 horizontal). Because of the relatively steep slope of the eastern side of the Landfill Site, a 60-mil thick high density polyethylene (HDPE) geomembrane was installed. A concrete mat was then placed over the geomembrane. Seven vertical seven-foot tall gas vents protrude through the cap.

The majority of rainfall that is intercepted by the northern one-third of the landfill drains to the west, and a smaller amount to the south. The majority of the rainfall intercepted by the middle third of the landfill drains to the south and southeast; only a minor amount drains to the west. The southern third of the landfill drains to the southwest and to the south.

A pond intercepts surface water run-off from the west landfill slopes. The pond, constructed during soil dredging operations, is located along the western margins of the landfill. Man-made drainage channels are located along the east and south margins of the landfill. The eastern channel is approximately 1200 feet long and drains from north to south. The southern channel is approximately 800 feet long. The southern drainage channel drains in a southeasterly direction. Both channels intercept a main drainage channel, oriented in an east-west direction, parallel to Highway 190. The main drainage channel, which begins approximately 4,000 feet east of the Site, flows from east to west and diverts surface water runoff from north of Highway 190 to the Fox River, approximately 1,000 feet west of the southeast corner of the Site. Flow in the Fox River is from north to south.

12.4 Site Geology

The Site overlies a surficial sand/gravel and dolomite aquifer system, which was contaminated by on-site disposal activities. The shallow aquifer system is comprised of two aquifer units:

- The sand and gravel aquifer unit consists of alternating clay, silt, and sand lenses in the glacial drift that lies directly beneath the Site. The thicknesses of the aquifer units vary between 20 and 60 feet and contain the A1 zone and the A2 zones described below.

- The Niagara aquifer unit (referred to as the A3 zone) is within the Niagara dolomite.⁴ The Niagara dolomite is reported to be 300 to 700 feet thick.

The Maquoketa shale aquitard lies between the Niagara dolomite and the deeper, confined sandstone aquifer. The shale varies from 90 to 210 feet in thickness. The confining Maquoketa Shale restricts vertical groundwater flow between the dolomite aquifer and the 1,100 to 2,000-foot thick underlying sandstone. The confining nature of the shale pressurizes the lower sandstone aquifer, creating an upward flow direction from the sandstone, known as an artesian condition.⁵ The relationship between these units is shown in Table 2 below.

Groundwater at the Site flows primarily to the south-southwest toward the Fox River through both the shallow aquifer system composed of sand and gravel glacial deposits and dolomite bedrock (A1, A2, and A3 zones), and the deeper sandstone system. The A1 zone of the sand and gravel system is continuous at the top portion of the aquifer system and groundwater flow velocity is estimated to be from 9 to 30 feet per year. At the lower portions of the sand and gravel system the aquifer is discontinuous. These discontinuous portions of the shallow aquifer system comprise the A2 zone and appear to be limited to the southeastern corner of the Site. The groundwater flow velocity in A2 is estimated at one to two feet per year. Groundwater velocity in the A3 zone is less than one foot per year. The relationship between the A1, A2, and A3 zones is depicted in Figure 3.

The saturated soils vary in thickness and lateral extent. The A1 and A2 zones of the shallow aquifer system respectively begin at 15 and 35 feet below the ground surface (bgs). The deeper Niagara dolomite (A3 zone) beneath the Site is generally found at depths ranging from 35 to 60 feet bgs. The Niagara Dolomite Aquifer (A3 zone) is the primary source of water for most residential and small municipal/subdivision systems. The sandstone aquifer, which is artesian, is the principal source of water for large municipal supplies and commercial/industrial users.

In the MDSL area, groundwater flow direction in the Sand and Gravel Aquifer (A1 and A2 zones) is generally south, along the Fox River floodplain. Flow direction east and west of the Fox River are generally toward the river. As the aquifer is penetrated by the Fox River, groundwater flow tends to exhibit an upward flow component, rising to discharge into the river. As a result, the entire Fox River represents a discharge area for groundwater within the Sand and Gravel Aquifer.

Flow direction within the Niagara Aquifer (A3 zone) is similar to the Sand and Gravel Aquifer, with minor differences as artesian conditions can be encountered (resulting in additional flow

⁴ The Niagara Dolomite aquifer has more recently been referred to as the Silurian Dolomite aquifer after the main Silurian formation in Wisconsin. It is present only in eastern Wisconsin. This relationship is shown in Table 2.

⁵ Since the beginning of the 20th century, increasing groundwater withdrawal from deeper high-capacity wells in the sandstone has caused a reversal in the upward vertical gradient. Water levels in the deep wells are now lower than the regional water table producing a downward flow and discharge to the deeper regional wells.

upward) or as bedrock lows intercept the groundwater flow and act as sinks. Two such lows are west and southwest of the MDSL Site and may be locally influencing the flow direction in the Niagara Aquifer giving it a southern component. Additionally, a subsurface fault may be influencing the flow direction in the Niagara by providing a means of downward percolation or lateral flow through the fault plane. In most cases, however, the flow direction in the Niagara is believed to be southerly along the Fox River floodplain.

Groundwater flow direction in the Sandstone Aquifer is generally from west to east across the region, but is locally influenced by two cones of depression in Waukesha, Wisconsin. These cones, caused by heavy pumpage in the city of Waukesha, create a southerly flow component in the Sandstone Aquifer in the MDSL area, resulting in an overall southeasterly flow direction beneath the Site.

TABLE 2: GEOLOGIC PROFILE AT THE MASTER DISPOSAL SERVICE LANDFILL

| GEOLOGIC UNIT | AGE | THICKNESS (FT) | HYDROGEOLOGIC UNIT | UNIT ORDER |
|--|---------------------------|----------------|----------------------------|---|
| Glacial Drift (A1 and A2 Zones) | Quaternary | 20-60 | Sand and Gravel Aquifer | <div>Most Superficial Unit</div> <div>↓</div> <div>Deepest Unit</div> |
| Niagara Dolomite (A3 Zone) | Silurian | 300-700 | Niagara Aquifer | |
| Maquoketa Shale | Ordovician | 90-210 | Aquitard | |
| St. Peter Sandstone Eau Claire Sandstone Mt. Simon Sandstone | Ordovician to Cambrian | 1,100-2,000 | Sandstone Aquifer | |
| Basement | Pre-Cambrian | N/A | N/A | |

Cited from RI Report, The Earth Technology Corporation, 1989

12.5 Current Groundwater Elevation Trends

The groundwater extraction system implemented as part of OUI was designed to provide hydraulic control at the downgradient boundary of the landfill in the A1 and A2 zones of the Site, as opposed to removal of contaminant mass from the saturated zone beneath the landfill. It was designed as such to prevent dewatering of the wetlands. The extraction system was operated from 1997 to 2003.

An evaluation of groundwater elevation trends and flow patterns was conducted for the shallower A1-A3 zone aquifers. Groundwater elevation data obtained in July 2003 during active pumping conditions; in July 2004 approximately 9 months after probationary shutdown of the extraction

system; and in July 2005 were plotted. All three zones indicate a general direction of groundwater flow toward the southwest during each measurement period, including periods of active pumping as well as after pumping had ceased.

To evaluate the effect of groundwater pumping conditions on hydraulic gradients, horizontal hydraulic gradients were determined between the upgradient and downgradient boundaries of the landfill in July 2003- July 2005. The results presented below show very low horizontal hydraulic gradients with little variation between measurement periods. The A2 zone also shows very low horizontal hydraulic gradients similar to those of the A1 zone. The A3 zone results show horizontal hydraulic gradients that are an order of magnitude lower than the other zones and minimal variation between the sampling periods. This lower horizontal hydraulic gradient translates into a much slower flow of groundwater in the A3 zone.

TABLE 3: HORIZONTAL HYDRAULIC GRADIENTS AT THE MASTER DISPOSAL SERVICE LANDFILL

| | Aquifer Zone Horizontal Hydraulic Gradients (ft/ft) | | |
|--------------------|--|-----------|-----------|
| Sample Year | A1 | A2 | A3 |
| July 2003 | 0.0023 | 0.0021 | 0.00042 |
| July 2004 | 0.0009 | 0.0017 | 0.00017 |
| July 2005 | 0.0018 | 0.0017 | 0.00011 |

The groundwater elevation, gradients and flow directions between July 2003 and July 2005 indicate that shutdown of the groundwater extraction system has not substantially modified the shallow A1 and A2 zone hydrogeologic flow systems. Similarly, the data confirmed that the groundwater extraction system has not affected groundwater elevations, gradients, or flow directions in the deeper A3 zone. The A1, A2 and A3 zones all show a general direction of groundwater flow toward the southwest, regardless of the presence or absence of groundwater pumping. Site groundwater flow velocities estimated as part of the RI are as follows:

- Zone A1 = 9 to 30 feet/year
- Zone A2 = 1 to 2 feet /year
- Zone A3 = less than 1 foot/year

12.6 Sampling Strategy

The sampling data collected for the development of the final groundwater remedy (OU2) is the monitoring data required under the implementation of OU1. The effectiveness and progress of OU1 has been tracked through the comprehensive monitoring program performed since October 1996 under pumping and non-pumping conditions. As detailed in Section 2.8.1, the monitoring was divided into three modules encompassing groundwater and wetlands, extracted groundwater

and surface water, and landfill gas monitoring. The monitoring was performed according to the approved monitoring plan as per the 1992 CD. On May 6, 1999, the PRPs petitioned for a reduction in the sample collection frequency via a two-year evaluation technical memorandum which summarized results from the monitoring and recommended revisions to the monitoring plan. EPA, in consultation with WDNR, approved the reduced monitoring proposal in January 2000 (see Section 9.8.2).

In May 2004, the PRPs requested a probationary shutdown of the existing extraction system based on the slow groundwater flow velocities and negligible changes in horizontal hydraulic gradients associated with the groundwater extraction system beneath most of the landfill area. Technical analysis demonstrated that turning off the extraction system would not change the local hydrogeologic flow system such that adverse impact to human health and the environment would result. The groundwater extraction system was shut down from October 2003 through October 2004, at which time a full year of post-shutdown groundwater data was collected to document that no adverse impact to human health and the environment resulted from the shutdown. The groundwater extraction system, though currently not operating, remains on-site should it need to be operated.

12.7 Groundwater Quality Evaluation

In order to evaluate groundwater quality and associated trends, the chemical-specific applicable or relevant and appropriate requirements (ARARs) are presented below. The chemical-specific ARARs are requirements that regulate the presence of specific chemical constituents in the environment. These requirements generally establish risk-based concentrations or discharge limits for specific chemicals and are generally determined based on human health risks. The following chemical-specific ARARs are relevant to the groundwater at the MDSL Site include:

- Wisconsin Administrative Code (WAC) Chapter NR 140: groundwater quality standards are established as Enforcement Standard (ES) values, which are equivalent to U.S. EPA Maximum Contaminant Levels (MCLs); and
- Preventive Action Limits (PALs) which are either 10 percent or 20 percent of the ES values, depending on whether the specific parameter has carcinogenic, mutagenic, teratogenic properties or interactive effects.

At the time that the probationary shutdown of the groundwater extraction system was requested, annual groundwater monitoring results were available from October 1997 – October 2003. These results indicated that two of the COCs identified in the 1990 ROD, 1,1-DCE and TCE, were no longer present in the groundwater. These contaminants may have naturally attenuated prior to implementation of the OU1 remedy. In addition, none of the remaining COCs identified in the ROD (i.e., arsenic, cadmium, chromium, copper, lead, methylene chloride, benzene, toluene and xylenes) were detected in the 1997-2003 groundwater samples from the Site monitoring wells at concentrations greater than the WAC Chapter NR 140 ES values or U.S.

EPA Safe Drinking Water Act (SDWA) MCLs as shown below in Table 4. The MCLs and ESs are the same, for each COC, and represent the groundwater cleanup criteria for the MDSL Site. The point of compliance of the identified cleanup goals is located just beyond the MDSL Site boundary but within the DMZ of the waste boundary. Pursuant to WAC Ch NR 140.22(3), the design management zone (DMZ) of the landfill extends horizontally beyond the waste boundary to a distance of 300 feet or the property line. The WAC Ch NR 140 groundwater quality standards are not required to be met within the DMZ, but must be met immediately outside of the DMZ boundary.

The data presented in Table 4 also allow a comparison between the 1997-2003 groundwater data and the 2004-2005 and 2006-2007 post-shutdown monitoring results to determine whether turning off the extraction system has adversely affected the groundwater quality. Table 4 shows that the maximum COC concentrations, except for lead and benzene, have decreased since the OU1 groundwater extraction system was shut-down in 2003 on a probationary basis. The maximum detected lead concentration (4.7 µg/L) was detected in a hydraulically upgradient, background well (B-48) within the A3 zone in October 2005. The maximum detected 2004-2005 lead concentration outside the DMZ and downgradient of the landfill was 3.4 µg/L (micrograms-per-liter or parts-per-billion) at an A1 zone well (B-60). The lead concentrations detected were well below the NR 140 ES.

Two A1 zone wells, PZ-02 and B-01, have shown benzene levels since the extraction system probationary shutdown. Benzene in the 2004-2005 groundwater samples occurred at PZ-02 (maximum concentration of 9.6 µg/L) and B-01 (maximum concentration of 1.2 µg/L). In 2006, benzene was detected in PZ-02 at 8.1 µg/L and B-01 at 1.3 µg/L. Both PZ-02 and B-01 are within the DMZ of the landfill where exceedances of the identified cleanup levels are allowable. In PZ-02, the benzene concentrations have ranged from non-detectable (less than 0.41 µg/L) to 9.1 µg/L, which is an exceedance of the WAC NR 140 ES of 5 µg/L. The remaining A1 zone wells did not have detectable benzene concentrations. The A2 and A3 zone wells did not show detectable concentrations of benzene. Well PZ-02 is located adjacent to the southern edge of the landfill and is approximately 21 feet deep. This well had not been sampled as part of the annual Site groundwater monitoring program prior to June 2004, but has since been sampled on a monthly basis.

TABLE 4: COMPARISON OF CHEMICALS OF CONCERN MAXIMUM LEVELS COMPARED TO GROUNDWATER ARARS

| Chemical of Concern | 1997-2003 Maximum Concentration | 2004-2005 Maximum Concentration | 2006-2007 Maximum Concentration | MCL ¹ | ES ² | PAL ³ |
|----------------------|---------------------------------|---------------------------------|---------------------------------|------------------|-----------------|------------------|
| Arsenic | 34.7J | 11 | 9.8 | 10 | 10 | 1 |
| Cadmium | 4.6J | 0.44Q | ND | 5 | 5 | 0.5 |
| Chromium | 6.4 | 2.4 | 1.4 | 100 | 100 | 10 |
| Copper ⁴ | 5J | 3.9 | 4.7 | 1,300 | 1,300 | 130 |
| Lead ⁴ | 1.1J | 4.7 | 0.96Q | 15 | 15 | 1.5 |
| Methylene Chloride | 0.62J | ND | ND | 5 | 5 | 0.5 |
| Benzene | 2 | 9.1 | 8.1 | 5 | 5 | 0.5 |
| Toluene | 0.77J | ND | ND | 1,000 | 1,000 | 200 |
| Xylenes | 1 | ND | ND | 10,000 | 10,000 | 1,000 |
| Trichloroethylene | ND | ND | ND | 5 | 5 | 0.5 |
| 1,1-Dichloroethylene | ND | ND | ND | 7 | 7 | 0.7 |

Note: All units are reported in micrograms per liter (ug/L); "J" represents laboratory qualified estimated values; "Q" represents analyte detected between limit of detection and limit of quantification.

¹ Maximum Contaminant Levels (MCLs) are promulgated under the federal Safe Drinking Water Act, 42 U.S.C. Sect. 300ff et seq. MCLs specify safe levels for drinking water contaminants measured at the tap from public water supplies.

² Enforcement Standards (ES) are adopted under the Wisconsin Administrative Code Section NR 140 as groundwater quality standards which the WDNR consistently applies to all facilities, practices and activities that may affect groundwater quality.

³ Preventive Action Limits (PALs) are contaminant-specific limits which signify a potential groundwater contamination problem. When PALs are exceeded for any constituent measured at a groundwater monitoring point, the WDNR must take action to manage or control the contamination so that the ES is not attained.

⁴ Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

The groundwater quality trends were evaluated for the VOCs of concern (i.e., benzene, toluene, xylene, and methylene chloride) for those wells where these chemicals were detected at levels exceeding their respective ES values. Benzene was the only chemical that met this criterion having exceeded its ES in PZ-02. This evaluation is necessary in order to determine whether a clear and meaningful trend of decreasing contaminant concentrations over time is being demonstrated in the Site groundwater. Such a determination provides an acceptable level of confidence that monitored natural attenuation (MNA) is occurring at the Site.

The trends and stability of benzene in groundwater were evaluated by using the Mann-Kendall Statistical Test for Trends, combined with the Coefficient for Variation Test for Stability on Non-Trending Data, as recommended by the WDNR for evaluating natural attenuation processes. The WDNR spreadsheet (Form 4400-215) was used, though it is limited to a maximum of ten data sets. To avoid bias associated with potential seasonal variation, the WDNR recommends use of more than one year of groundwater monitoring data for this statistical approach. Quarterly data points collected in March, June, September and December, beginning with the first sampling event in June 2004 and ending in November 2006 were used (see Appendix E).

To evaluate the complete PZ-02 data set, benzene concentrations versus time were graphically plotted to produce a trend line showing an overall decrease in benzene levels from June 2004 through November 2006. The observed stable or decreasing benzene concentration trend is significant in that it represents the primary line of evidence for natural attenuation of groundwater at the Site (see Figure 4).

A screening contaminant transport evaluation was performed to evaluate the downgradient attenuation of the detected benzene in groundwater at PZ-02 due to geometrical spreading within the saturated zone in order to determine if benzene is, or is likely to be exceeded at the Site property line.

12.8 Contaminant Transport Evaluation

A one-dimensional steady flow and transverse dispersion model (Domenico and Palciauskas, 1982) was used to perform a screening evaluation of maximum downgradient benzene concentrations. The objective of the contaminant transport screening evaluation is to assess the downgradient attenuation of benzene due to geometrical spreading within the saturated zone. A further evaluation was subsequently conducted employing the BIOSCREEN Model to simulate remediation through natural attenuation of dissolved benzene. The model simulates advection, dispersion, adsorption, and aerobic decay, as well as anaerobic reactions. As such, the model provides an estimate of whether or not minimum performance standards will be achieved at an alternative boundary.

For the purposes of this assessment, the alternative boundary of interest was the hydraulically downgradient MDSL Site boundary in closest proximity to well PZ-02. The distance between well PZ-02 and closest downgradient MDSL Site boundary (to the south of PZ-02) is 50 feet. However, the nearest downgradient groundwater receptor is a car dealership potable well which is located approximately one-quarter of one mile to the southwest of the MDSL Site. The modeling was performed using conservative assumptions and the maximum detected concentration of benzene (9.6 µg/L) at PZ-02. Two scenarios were considered for benzene degradation: 1) that no biodegradation occurs; and, 2) that the conservative half-life of benzene is two years based on measured dissolved oxygen values. For the model parameters not based on site-specific measured values, such as porosity, dispersivity, area width and thickness, source half-life and soluble benzene mass, conservative values, i.e., values that would produce the

highest downgradient benzene concentrations, were used. Other parameter values were used to produce conservatively high benzene solute transport rates.

The model results showed that at a distance of 50 feet downgradient of PZ-02, under the most conservative assumption that no biodegradation of the benzene occurs, a maximum benzene concentration of 3.27 ug/L was calculated. When biodegradation is assumed to occur using the benzene solute half-life of two years, the model predicts a benzene concentration of 2.28 ug/L at a distance of 50 feet downgradient of PZ-02. The ARAR for benzene at the Site is the WAC Ch NR 140 ES of 5 ug/L. The BIOSCREEN Model results predict that this ARAR will be met based on the following temporal and spatial conditions:

If the natural attenuation processes of longitudinal and transverse dispersion are not considered, and a benzene (biodegradation) half-life of two years is assumed, the ARAR could be met within a two-year period. This is because the maximum detected value (9.6 ug/L) when subjected to the two-year half-life would result in a downgradient benzene concentration of 4.8 ug/L after two years.

The modeling performed to date estimates that the likelihood of benzene exceeding the ES at a downgradient receptor well is relatively low to non-existent. In this kind of screening analysis, however, the model parameters used must be further validated or replaced with site-specific data, such as a sampling point, such as a piezometer, downgradient of the landfill but upgradient of the Fox River. Sampling data from such a location could serve two purposes: 1) determining actual groundwater concentrations of benzene, and 2) providing additional data with which to test these calculations. The RD phase will determine whether and how a groundwater quality investigation will be conducted to field-verify the estimated maximum concentrations of benzene in this portion of the Site. A monitoring well was not originally installed in the wetlands area between PZ-02 and the Fox River as this area does not easily support the necessary drilling equipment. The nested observation wells (OB-07, OB-08, and OB-09) have been used to collect these downgradient data.

The available groundwater monitoring information to date indicates that benzene concentrations in shallow groundwater at PZ-02 have remained relatively low and stable since shutdown of the groundwater extraction system. Benzene was also detected in well B-01; however, no ES exceedances were reported at B-01. Benzene was not detected in any other wells, including wells downgradient of PZ-02 and B-01 or any wells located in the deeper A2 and A3 aquifers. The monitoring wells located between PZ-02 and the downgradient car dealership potable well include B-43, B-60, OB-7S, OB-7I, OB-8I, OB-8D, and OB-9D. Benzene has never been detected in these monitoring wells, which represent sentinel wells for the potable well. Therefore, natural attenuation of the benzene appears to be occurring and the detected benzene concentrations in wells PZ-02 and B-01 do not pose a risk to public health.

Further, Table 4 shows that the other groundwater constituents have also decreased, and the organic parameters, except for benzene, are no longer detectable at the Site monitoring wells and downgradient wells.

12.9 Monitored Natural Attenuation (MNA) Parameters

A second line of evidence provided to support the efficacy of MNA at groundwater sites is the hydrogeologic and geochemical data at the Site. These data indirectly demonstrate that natural attenuation is occurring. Some of the parameters indicative of an environment that supports natural attenuation at the MDSL Site are discussed below. In general, there are three general groups of chemical changes that occur: electron acceptors, metabolic byproducts, and daughter products. Electron acceptors are elements or compounds that occur in relatively oxidized states and include dissolved oxygen, nitrate, ferric iron, manganic manganese, hydroxide, sulfate, and carbon dioxide. These compounds are reduced through oxidation and reduction reactions during microbial respiration to yield energy to the microorganisms for growth and activity. Dissolved oxygen (DO) is typically the first electron acceptor to be used in the biodegradation of organic compounds, including constituents of petroleum hydrocarbon fuels. As a consequence, the concentration decreases and DO levels below background indicate aerobic biodegradation is occurring. After DO concentrations in the aquifer fall below about 0.5 mg/L, anaerobic processes (initially denitrification) will begin if sufficient anaerobic electron acceptors are present.

Dissolved oxygen concentrations were obtained in groundwater samples from Site monitoring wells as part of the annual 2006 groundwater monitoring event. The DO concentrations ranged from 2.05 mg/L to 3.94 mg/L, with an average of 2.81 mg/L. A DO concentration of 2.30 mg/L was detected at PZ-02; only two other wells had lower DO levels. The somewhat depleted DO levels at PZ-02 may be indicative of aerobic biodegradation within the localized dissolved benzene plume at that location.

Ferrous and Ferric Iron

In some cases ferric iron is used as an electron acceptor during anaerobic biodegradation of organic hydrocarbons. During this process, ferric iron is reduced to the ferrous form, which is more soluble in water. Ferrous iron concentrations can therefore serve as an indicator of anaerobic degradation of hydrocarbons. As per the 2006 Annual Monitoring Report for the Site, the average concentration of dissolved iron in Site monitoring wells is 1.68 mg/L. The reductive pathway for degradation is supported at dissolved iron concentrations that exceed 1 mg/L (USEPA, 1998). As such, the detected dissolved iron concentrations are indicative of geochemical conditions that probably contributed to the dechlorination of the chlorinated COCs, i.e., TCE, 1,1-DCE and methylene chloride. These COCs are no longer detected in Site monitoring wells.

12.10 Conceptual Site Model

See Figure 5.

13.0 Current and Potential Future Site and Resource Uses

13.1 Water Resources and Use

The general Brookfield area is experiencing rapid growth. The city of Brookfield is a heavily urbanized area located approximately three-quarters of one mile east of the Site. A western suburb of Milwaukee, the city of Brookfield covers 26 square miles with a total population of about 39,000. As of the 2000 census, about 13,500 people live within a three-mile radius of the MDSL Site. Over 2,350 persons are estimated to be served by private wells within a three-mile radius of the Site east of the Fox River. In 2006, a potable well survey conducted by the PRPs indicated that there are 21 private drinking water wells within one mile of the Site (see Figure 6). However, only one of the 21 wells is potentially subject to Site-related contamination because it is situated hydraulically downgradient of the Site about one-quarter mile southwest of the Site (Figure 1).

The city of Brookfield municipal water utility supplies drinking water to about 63 percent of the residents of Brookfield. Consisting of 23 wells, five towers, seven reservoirs and nine booster stations, its capacity is about four million gallons-per-day. Ten of the city wells are located within a three-mile radius of the Site. A number of the city wells draw from the Niagara Dolomite aquifer A3 zone. The city water utility is actively drilling for new wells on the south side of the city.

The town of Brookfield water supply (Sanitary District No. 4) consists of six wells also drawing from the Niagara Dolomite Aquifer (A3 zone). The closest District well is located two miles south of the Site along Barker Road. The District provides an average of 1.2 million gallons-per-day of water to about 6,400 people. None of the town water supply lines reach the Site vicinity; hence, all water supplies within a one-mile radius of the Site are served by private wells. As mentioned, all but one of these private wells are hydraulically upgradient of the Site and not subject to Site-related groundwater contamination.

13.2 Land Resources and Use

The Site sits near the northwest corner of the city of Brookfield. The land use in this area is currently semi-rural, mixed-use land and includes commercial, residential, and light industrial uses. The Site is immediately surrounded by a conservancy area with abundant wetlands and drainage areas for the Fox River and Sussex Creek. These wetlands comprise the majority of land around the Site and fall within the 10-year flood line. Hence, it is unlikely that any future development could occur within this vicinity of the landfill.

Forty acres of the Site property are classified by the county of Waukesha as undeveloped or open land. A 0.61-acre subparcel of the property fronting Capitol Drive was zoned residential at one time, but is currently zoned as transitional. An old concrete block building currently used to store automotive equipment sits within the Site perimeter fence on the 0.61-acre parcel. The building was used as a repair garage when the Site operated as a landfill. After the Site was placed on the NPL, the building was leased for the repair of vehicles. The building was slated for demolition in order to build an on-site groundwater treatment plant under the preliminary remedial design; however, a revised treatment scheme no longer included a treatment building. After the original owners passed away, the building and property on which it sits have been maintained by the decedents' son.

14.0 Summary of Current Site Risks

As detailed in Section 2.5 of this document, a baseline risk assessment was completed for the MDSL Site in November 1989. The result of that risk assessment was the basis for undertaking OU1. These details can be found in the September 1990 ROD for OU1. There were no additional risk assessment activities performed in anticipation of OU2 because OU1 has already addressed all of the exposure pathways identified by the baseline risk assessment. The current risk at the MDSL Site is residual risk that has not been fully mitigated by OU1. This risk includes:

- 1) Potential risk from drinking contaminated groundwater in areas where cleanup levels have not yet been met;
- 2) Potential risk that Site groundwater contamination will migrate to aquifer areas currently used as a drinking water source; and
- 3) Potential risk that the Site property may be used inappropriately, disturbing the integrity of the cap and causing a direct contact risk from Site contamination.

Regarding Item 1, the locations where contaminated groundwater has not yet met acceptable risk based cleanup levels for human health (i.e., ES and MCLs) exist onsite and within the DMZ zone of the landfill only. At the present time, there is no risk attributable to Item 1. The implementation of Institutional Controls (ICs) at the Site, as specified under OU1, will prevent the future installation of drinking water wells on the Site and within the DMZ. Water used at the Site in the future would need to be transported in since no municipal or township water lines supply this area.

The potential for groundwater contamination to migrate to aquifer areas used as a drinking water source (Item 2) has been addressed by the groundwater extraction and treatment, and is currently being addressed under the source control measures of OU1 (landfill cap) and the natural attenuation processes that continue to occur since the groundwater system was turned off. The

MNA will continue to address this risk in the future.

The 1989 baseline risk assessment for the ingestion of contaminated groundwater presented a lifetime cancer risk for adult populations of 7×10^{-5} in the worst-case scenario and 2×10^{-5} in the most probable case scenario. For the child population, a lifetime cancer risk of 1×10^{-3} and 7×10^{-5} for the worst-case and most probable case scenarios were respectively presented. The benzene downgradient groundwater concentrations used in these calculations were 91 ug/L (maximum) and 1.93 ug/L (geometric mean). The estimated exposure doses for 1,1-DCE, TCE, benzene, toluene and cadmium all exceeded Federal and State ARARs for groundwater, i.e., MCLs and ESs for the worst-case scenarios.

The present downgradient groundwater concentrations for these COCs (Table 4) show the maximum benzene level to be 8.1 ug/L. The other COCs used in the 1989 risk assessment are either no longer present in the downgradient groundwater, or are present at concentrations below the ARARs. Hence, the additive risk from ingestion of downgradient groundwater is estimated to be over an order of magnitude less than the 1989 risks.

The interim groundwater remedy under OU1 has been operating for 10 years. During that time, the groundwater has been remediated through the groundwater extraction and treatment system for the first six-and-one-half years, and through MNA during the latter three-and-one-half years after the pump and treat system was turned off. All COCs at the Site, except for benzene, have either been cleaned up to levels below the groundwater cleanup criteria set forth in this document for OU2, or as in the case of arsenic, does not significantly differ from naturally occurring background levels in the regional groundwater.

There is no risk posed by benzene from ingesting groundwater off-site because it is being attenuated in the aquifer before reaching any existing downgradient private wells. Any benzene that may reside in shallow groundwater discharged to the intervening wetland between the Site and any downgradient wells would volatilize immediately.

Arsenic has not been detected above the WDNR Enforcement Standard of 50 ug/L. In 2006, the WDNR reduced the arsenic ES to 10 ppb. Since October 2003, no exceedance beyond the ES of 10 ug/L for arsenic has occurred outside the Site boundary. A statistical comparison of upgradient to downgradient concentrations and trend analyses indicated that the presence of arsenic is likely to be a naturally occurring condition. Similar analyses for iron also produced the same conclusion. Both of these naturally occurring constituents produce negligible risk at the Site.

Regarding Item 3, i.e., the potential risk that the Site property may be used inappropriately, disturbing the integrity of the cap and causing a direct contact risk from Site contamination, will also be addressed by the implementation of ICs at the Site.

The response action selected in this Record of Decision is necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from

this Site which may present an imminent and substantial endangerment to public health or welfare.

15.0 Remedial Action Objectives (RAOs) for OU2

The purpose of this OU2 is to address any residual Site risks associated with future groundwater use. This will be achieved by defining the groundwater remediation standards that must be met at the Site. These standards must protect human health and the environment. The federal SDWA specifies MCLs for drinking water contaminants measured at the point of use from public water supplies. In the case of the MDSL Site, the contaminants, namely benzene, are in a groundwater supply which is used by private well users; hence, MCLs are not legally applicable, but are relevant and appropriate remediation goals for groundwater.

The State of Wisconsin has promulgated groundwater quality standards in Ch. NR 140, which the WDNR consistently applies to all facilities, practices and activities that may affect groundwater quality. These legally applicable, relevant and appropriate standards include Enforcement Standards (ESs) and Preventive Action Limits (PALs). PALs are contaminant-specific limits that signify a potential groundwater contamination problem. When PALs are exceeded for any constituent measured at a groundwater monitoring point, the WDNR is required to take action to manage or control the contamination so that the ES is not exceeded. The Wisconsin chemical-specific ES are set at the same concentration as MCLs (see Table 4).

The state ESs and MCLs will be the cleanup levels and the basis on which the groundwater restoration time frame and long-term monitoring criteria will be developed for the Site.

The RAOs of the proposed OU2 include:

1. Protect human health and the environment from exposure to contaminated groundwater via drinking and direct contact;
2. Protect existing and future residential water supplies from potential migration of contaminated groundwater;
3. Restore the groundwater to comply with state and federal groundwater standards within a reasonable time frame;
4. Optimize both groundwater restoration and wetlands vegetation preservation.

The Feasibility Study (FS) performed in 1990 developed various remedial source control alternatives which were subjected to a detailed analysis using the following standard nine criteria recommended by EPA (see Section H of this document). Under the OU1 FS, containment/control of the contaminated groundwater plume, as well as the ability to achieve health protective cleanup goals consistent with ARARs in downgradient groundwater were evaluated during the selection of the OU1 remedy. The OU1 remedy included a groundwater containment and

remediation component that has been operating since 1997. The subsequent development of OU2 is based on the OU1 FS (1990) as well as Site groundwater data collected since 1997.

16.0 Description of Alternatives for OU2

The following three alternatives have been developed to address the RAOs for OU2. It must be remembered that under any and all circumstances, OU1 consisting of the landfill cap with active gas venting system, monitoring of ground and surface water hydrology to assess quality and quantity of the area groundwater, surface water, and wetlands remains in place and is not affected by the final selected groundwater remedy under OU2. Consistent with the expectations set forth in Superfund law, none of the alternatives considered for OU2 rely exclusively on ICs to achieve protectiveness.

- Alternative 1: No Action
- Alternative 2: Monitored Natural Attenuation (MNA) with contingent groundwater extraction and on-site treatment
- Alternative 3: Groundwater extraction and on-site treatment

16.1 Common Elements and Distinguishing features of Each Alternative

This section of the ROD describes those components that are common to each of the remedial alternatives except for the No Action Alternative (Alternative 1). Common remedial components to the remedial alternatives include groundwater monitoring program and five-year reviews. Alternatives 2 and 3 also include the establishment of groundwater cleanup criteria. The ICs, as required by the earlier 1990 ROD for the Site, are to ensure that no extraction, consumption, or other use of groundwater from beneath the Site occurs; no interference with construction, operation and maintenance (O&M), monitoring, and efficacy of any components or improvements resulting from the RA occurs; no inappropriate use of the landfill cap area or other areas containing RA components occurs; and that no construction, installation, or use of any buildings, wells, roads or structures on the facility property that could affect the integrity, O&M, or efficacy of the remedy occurs.

Alternative 2, MNA, includes a contingency for more frequent contaminant monitoring should increasing benzene trends or concentrations be detected. Further, Alternative 2 includes the contingency for turning on the groundwater extraction system when monitoring indicates a potential failure of the Selected Remedy (i.e., triggering criteria are exceeded) signaling that benzene or other contaminants may exceed the cleanup levels beyond the DMZ boundary. The extracted groundwater would be discharged to the on-site pond for treatment. The contingency under Alternative 2 allows for site-specific adjustments as the need arises.

Alternative 3 specifies that the current on-site groundwater extraction system, or a subset of wells thereof, operate continually at a low flow extraction rate, except during the winter, in order to contain groundwater contaminants within the Site boundary. Extracted groundwater would be discharged to the on-site pond for treatment. Under this alternative, monitoring of the water budget is necessary to ensure that the wetlands are not adversely affected or dewatered.

The expected outcomes of Alternatives 2 and 3 are the same in that the available time frames to clean up the groundwater are the same, and the available uses of the groundwater post-remediation are the same.

Alternative 1: No Action

Estimated Capital Cost: \$0

Estimated Annual O&M Cost: \$0

Estimated Present Worth Cost: \$0

Estimated Construction Timeframe: None

Regulations governing the Superfund program generally require that the “no action” alternative be evaluated to establish a baseline for comparison. Under this alternative, EPA would take no further action at the Site concerning the groundwater beyond what has been provided for under the source control OUI as currently operated, i.e., no active pumping and treating of the groundwater. Because extraction and treatment of the groundwater was an interim action component of the overall remedy under OUI, it is not considered a final groundwater remedy. The components of the OUI remedy (i.e., landfill cap with landfill gas venting, groundwater monitoring, and ICs) would remain in place for all three alternatives. The 1990 ROD for OUI should be consulted for more details.

Alternative 2: Monitored Natural Attenuation with Contingent Groundwater Extraction and Treatment

Estimated Capital Cost: \$0

Estimated Annual O&M Cost: \$21,000 - \$27,000

Estimated Present Worth ⁶ Cost: \$261,000 - \$335,000

Estimated Construction Timeframe: None

Estimated Time to Achieve RAOs: Less than 5 years⁷

Under this alternative, the contamination in the groundwater would be allowed to clean itself up through natural physical, chemical, and biological processes known as natural attenuation. A critical component of natural attenuation is the monitoring of groundwater at certain locations at the Site boundary and downgradient of the landfill to ensure that contaminants do not move off-site via the groundwater. This alternative also includes the establishment of groundwater cleanup

⁶ Present worth estimate is based on 30 years at a discount rate of seven percent.

⁷ This time period is an estimate based on the current trend.

levels. Compliance with the chemical-specific groundwater cleanup levels in groundwater is determined at the DMZ, which is beyond the Site boundary but within 300 feet of the landfill boundary; these cleanup levels do not have to be met throughout the landfill. Should monitoring indicate a potential failure of the Selected Remedy (i.e., triggering criteria are exceeded) signaling that benzene or other contaminants may exceed the cleanup levels beyond the DMZ boundary, the on-site groundwater extraction system will be reactivated to pull back the contaminated groundwater.

Under this contingency, the extracted groundwater would be discharged to the on-site pond on the west side of the landfill where contaminants are biologically degraded. The treated water is eventually discharged from the pond to the drainage system feeding the Fox River. Because of the sensitive wetland areas surrounding the Site, the water levels and the wetlands would need to be regularly monitored to ensure that the extraction of groundwater from the hydrological system does not dewater the wetland. A wetlands vegetation assessment would need to be conducted at regular intervals to ensure that the wetlands ecosystem has not been adversely affected.

The estimated time period to achieve RAOs is an estimate based on the monitoring results and trend analysis of one well. Though all of the monitoring wells in the network are tested, only one well (PZ-02) has shown benzene--the only COC that has been consistently detected due to past disposal activities at the Site. Over the last three years, benzene levels in the well have ranged from no detection to 9.6 ppb.

Alternative 3: Pump and Treat the Groundwater with Biological Treatment before Discharge

Estimated Capital Cost: \$30,000 - \$50,000

Estimated Annual O&M Cost: \$41,000 - \$57,000

Estimated Present Worth Cost: \$539,000 - \$757,000

Estimated Construction Timeframe: 3-5 months

Estimated Time to Achieve RAOs: Less than 5 years

This alternative specifies that the existing groundwater extraction system, or a portion thereof, be recommissioned to actively contain the groundwater contaminants within the DMZ at a low flow state, without aggressive groundwater removal from the overall hydrogeological system. The extracted groundwater would be discharged to the on-site pond on the west side of the landfill where contaminants are biologically degraded. The treated water is eventually discharged from the pond to the drainage system feeding the Fox River. As was the practice during the six-and-one-half-year period when the groundwater extraction system was operating, the system would not be operating from November through March when the temperatures are too cold to support natural biodegradation in the treatment pond.

This alternative also includes the establishment of chemical-specific groundwater cleanup levels that comply with ARARs and must be achieved at the DMZ. Because of the sensitive wetland areas surrounding the Site, the water levels and the wetlands would need to be regularly monitored to ensure that the extraction of groundwater from the hydrological system does not

dewater the wetland. In addition, a wetlands vegetation assessment would need to be conducted at regular intervals to ensure that the wetlands ecosystem has not been adversely affected.

17.0 Comparative Analysis of Alternatives

This section discusses the relative performance of each alternative that was evaluated against the nine criteria, noting how it compares to the other options under consideration. State acceptance has been considered during the selection of the alternative; community acceptance was evaluated during the public comment period. Of these nine criteria, the Selected Remedy meets the threshold criteria of protecting human health and the environment and complying with ARARs. The balancing criteria and the modifying criteria were also assessed to arrive at the Selected Remedy.

17.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether or not an alternative provides adequate protection and describes how risks are eliminated, reduced or controlled through treatment and engineering or ICs.

All of the alternatives, except the No Action alternative, protect human health and the environment by eliminating, reducing, or controlling risks posed by the Site through treatment of groundwater contaminants, engineering controls, and/or ICs. Extraction, treatment and natural attenuation of the groundwater have occurred over the past 10 years that the source control remedy (OUI) has been operating. This source control remediation combined with the Site access restrictions has reduced potential exposures to contaminants and the associated risks both onsite and offsite. Both Alternatives 2 and 3 protect human health and the environment because they require health protective groundwater cleanup levels to be established for the Site. Contaminants exceeding these cleanup levels would not be allowed to migrate off-site under both Alternatives 2 and 3. Further, Alternative 2 would not adversely impact the surrounding wetlands because the critical water balance would be maintained.

17.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as “ARARs,” unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent

than federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not “applicable” to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate. The federal and state ARARs are presented in Table 3.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for invoking a waiver.

One purpose of OU2 is to define the groundwater remediation standards that must be met at the Site. Both Alternatives 2 and 3 go beyond the scope of the interim groundwater remedy of OU1 in that they would establish chemical-specific cleanup levels to be met in the groundwater at the DMZ boundary. Except for the No Action alternative, Alternatives 2 and 3 have common ARARs associated with the drinking water standards for groundwater. Both of the considered alternatives will attain their respective Federal and State ARARs. However, drinking water standards will not be met through Alternative 2, MNA, for approximately 5 years. These standards are not likely to be met any sooner through Alternative 3, the pump and treat alternative, because the contaminant levels in the Site groundwater are approaching or have achieved asymptotic levels.

17.3 Long-term Effectiveness and Permanence

Long-term effectiveness and permanence refers to the ability of an alternative to maintain reliable protection of human health and the environment, over time, once cleanup objectives have been met. This criterion includes the consideration of residual risk that can remain onsite following remediation and the adequacy and reliability of controls. Each alternative, except for the No Action alternative, provides some degree of long-term protection. Alternatives 2 and 3 are both effective in the long term as they have the same target endpoints, i.e., achievement of Federal and State groundwater ARARs. Both Alternatives 2 and 3 would also require approximately the same amount of time to achieve the cleanup levels. Alternative 3 could potentially affect the wetlands because groundwater would be actively withdrawn from the local hydrological system. This could contribute a measure of instability to the Site, and monitoring would be needed to ensure that dewatering of the wetlands does not occur.

17.4 Reduction of Toxicity, Mobility, or Volume

Reduction of toxicity, mobility, or volume is the anticipated performance of the treatment technologies that may be included as part of the remedy. Alternative 1 would not reduce the

toxicity, mobility, or volume of the waste because it would allow the continued movement of contamination through the aquifer. Alternatives 2 and 3 meet this criterion and achieve the same endpoint. Alternative 2 provides for natural degradation of the benzene and other residual contaminants in the groundwater in a passive and non-disruptive manner. Alternative 3 would reduce the toxicity, mobility and volume of the waste as well, however, it is not likely to be as effective as Alternative 2, because it involves actively removing the contaminated groundwater which ultimately creates a higher potential risk to the wetlands due to the water withdrawal via the extraction wells. Further, depending on the dispersion of the benzene, it may be difficult to achieve benzene levels below 5 ug/L via low flow extraction and treatment.

17.5 Short-term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved. All three alternatives present little/no risk during the implementation period. Alternative 2 has no construction or implementation timeframe to contend with. Alternative 3 requires a three to five-month implementation time to recommission the on-site groundwater pump and treat system.

17.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered. Alternative 1 could be easily implemented since it involves no action. Alternative 2 is easier to implement than Alternative 3, unless however, if the groundwater extraction and treatment are triggered by an exceedance of the benzene criteria. Under this condition, the relative implementability between Alternatives 2 and 3 will be insignificant. Alternative 3 should be easily implementable since its components-- the groundwater extraction and treatment system-- are already on-site and available. Redevelopment of one or more extraction wells will be necessary.

17.7 Cost

Cost includes capital costs, as well as operation and maintenance costs. Alternative 1 is the least expensive alternative. On the surface, Alternative 2 is approximately one-half the cost of Alternative 3 because most of the costs are for monitoring instead of active remediation, as in Alternative 3. However, because Alternative 2 is a contingency remedy, future work may be indicated which could approach the costs of Alternative 3.

17.8 State Acceptance

The WDNR has expressed its support for Alternative 2 and has provided a letter of concurrence (see Appendix B).

17.9 Community Acceptance

During the public comment period, one comment was received indicating a preference for Alternative 3 (see Appendix C).

18.0 Principal Threat Waste

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(iii)(A)). Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. The manner in which principal threats are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied.

When the MDSL Site was listed on the NPL, the presence of principal threat wastes had been confirmed at the Site. The Superfund remedial process was undertaken to mitigate those wastes. The principal threat wastes have been contained and treated at the Site under the implementation of OU1, which included an interim groundwater remedy component. At the present time, the only remaining wastes at the Site which have not been addressed are non-principal threat. These wastes will be dealt with under the implementation of OU2 as a final remedy.

19.0 Selected Remedy

EPA had recommended at the start of the public comment period that the Preferred Remedy for cleaning up the groundwater (OU2) at the Master Disposal Services Landfill Site is Alternative 2 (Monitored Natural Attenuation with Contingent Groundwater Extraction and Treatment). Since the public comment period has been held, one comment was made by the public, but no comments were made that warranted a change from EPA's recommended cleanup alternative. EPA now affirms that Alternative 2 is the Selected Remedy for the Site. The WDNR, as the support agency, concurs with EPA's Selected Remedy and has provided a letter of concurrence.

Components of this alternative include setting forth groundwater cleanup levels and establishing a long-term groundwater monitoring program to ensure the effectiveness of the MNA remedy and the protection of human health and the environment.

A primary goal of OU₁ is to establish chemical-specific groundwater cleanup levels that comply with federal and state ARARs for the COCs. The State of Wisconsin has promulgated groundwater quality standards in Ch. NR 140, which the WDNR consistently applies to all facilities, practices and activities which are regulated by WDNR and may affect groundwater quality. These standards include Preventive Action Limits (PALs) and Enforcement Standards (ES). When PALs are exceeded for any constituent measured at a groundwater monitoring point, the WDNR is required to take action to manage or control the contamination so that the ES is not exceeded. An exceedance of a PAL does not necessarily trigger remedial action as long as protectiveness is maintained.

The SDWA specifies MCLs for drinking water contaminants measured at the point of use from public water supplies. In the case of the MDSL Site, the contaminants are in a groundwater supply aquifer which is used for consumption by private and municipal well users; hence, contaminant-specific MCLs are applicable, relevant and appropriate requirements (ARARs) for the groundwater. The Wisconsin chemical-specific ESs are set at the same concentration as MCLs and are also ARARs for the groundwater quality. PALs are more stringent than ESs and MCLs. The current MCLs, PALs and ESs for the MDSL Site groundwater COCs, along with the latest Site maximum groundwater contaminant levels, are listed in Table 4.

Well (PZ-02) has been the only well showing benzene detections above the ES and MCL so far and therefore, will be the focus of the monitoring efforts. Additional benzene monitoring data will enable EPA to determine whether natural attenuation is succeeding. Well PZ-02 is located at the southern edge of the landfill within the design management zone (DMZ) of the landfill. Figure 7 depicts the relationship between the landfill boundary, Site boundary, and the DMZ boundary. The DMZ is designated as a zone 300 feet horizontally from the landfill perimeter or the property boundary. According to WAC NR 507.28, exceedances of the ES within the DMZ require monitoring but not active remediation. Hence, benzene must be monitored in the DMZ or it must be effectively demonstrated that the ES for benzene is not exceeded beyond the DMZ. The monitoring plan will include the use of long-term monitoring wells to determine if the plume behavior is changing and performance evaluation wells to confirm that contaminant concentrations meet the groundwater ARARs outside of the DMZ. The monitoring may also include the regular collection of appropriate geochemical indicators, such as DO, pH, temperature, redox potential, near the source area to ascertain the effectiveness of natural attenuation in the affected aquifer zones.

The existing Site groundwater monitoring program (see Table 1) will be evaluated and modified as necessary during the RD phase to include criteria for invoking the contingency groundwater extraction and treatment remedy under this alternative.

The triggering criteria will consider the following for inclusion:

- Increasing contaminant concentrations in groundwater or the appearance of free product in monitoring wells;

- Near-source wells exhibit large concentration increases indicative of a new or renewed release;
- Contaminants are identified in monitoring wells located outside of the original plume boundary;
- Impacts to nearby receptors and potable wells indicating that MNA is not protective;
- Contaminant concentrations are not decreasing at a sufficiently rapid rate to meet the remediation objectives;
- Concentrations of geochemical parameters are changing such that they indicate a declining capacity to support biodegradation of contaminants; and
- Changes in land and/or groundwater use will adversely affect the protectiveness of the MNA remedy.

These criteria, when exceeded, would activate measures to ensure that human health and the environment remain protected. These measures may include increased monitoring frequency at the Site or DMZ boundary and additional monitoring point(s) for benzene immediately downgradient of the DMZ or Site boundary to ensure that the benzene and other contaminants meet cleanup criteria outside the DMZ. Ultimately, activation of the groundwater extraction and treatment system with discharge to the surface water drainage system may be required. If the groundwater extraction system is activated, then the wetlands water budget and vegetation surrounding the Site would need to be evaluated on a regular basis.

Alternative 2 was selected over the other alternatives because it is expected to achieve risk reduction by meeting Site remedial action objectives, i.e., protect human health and the environment from exposure to contaminated groundwater; protect existing and future residential water supplies from the potential migration of contaminated groundwater; restore the groundwater to comply with state and federal groundwater standards; and, optimize both groundwater restoration and wetlands vegetation preservation within a reasonable time frame and cost compared to the more active extraction and treatment alternative.

Based on the information available at this time, EPA and WDNR believe that Alternative 2 will be protective of human health and the environment, attain the ARARs, and be cost-effective. This action uses a permanent but passive solution to reduce waste volume, mobility, and toxicity via natural attenuation. Alternative 2 also provides a contingency system to actively remove and treat groundwater contamination should monitoring results indicate that MNA is not performing optimally, i.e., contaminant levels show an increasing trend, or contaminants have exceeded a trigger level at the Site boundary or the DMZ that is protective of human health and the environment downgradient of the landfill. Alternative 2 is less expensive and more protective of

the wetlands than Alternative 3 because the water balance in the area will not be affected under MNA conditions.

The costs associated with the Selected Remedy are minimal. There is no expected capital cost involved. If additional groundwater monitoring point(s) are deemed necessary, the estimated capital cost would not be expected to exceed \$ 12,000 - \$15,000. The estimated annual O&M cost ranges between \$21,000 - \$27,000. The estimated present worth cost is \$261,000 - \$335,000. This cost estimate is based on the best available information regarding the anticipated scope of the remedial alternative. Any unanticipated major changes may be documented in a memorandum to the Administrative record file.

19.1 Expected Outcome of Selected Remedy

The expected outcome of the Selected Remedy will be to prevent contaminated groundwater from migrating beyond the DMZ. The monitoring and contingency actions will also ensure that contaminant concentrations in the groundwater are decreasing and that the groundwater contamination does not expand beyond the DMZ. The monitoring will also ensure that any increases in the levels of contaminants do not impact the wetlands or the Fox River.

20. Statutory Determinations

Under CERCLA §121 and the NCP, the U.S. EPA must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and has a bias against off-site disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

20.1 Protection of Human Health and the Environment

The Selected Remedy, Alternative 2, will treat benzene-contaminated groundwater via monitored natural attenuation. This remedy will protect human health and the environment by removing the contamination to Federal drinking water standards. The current benzene levels in the groundwater are within the same order of magnitude as Federal drinking water standards and state groundwater quality protection standards for benzene (5 ug/L) and range from nondetectable to 9.6 ug/L. The current carcinogenic risks from benzene at the Site are at the lower end of EPA's target risk range (10^{-4} to 10^{-6}). The Selected Remedy is expected to lower the risk further and is within the magnitude of 1×10^{-6} . There are no short-term threats associated with the Selected Remedy that cannot be readily controlled via strict adherence to the current O&M Plan for the Site, the Site Health and Safety Plan, and/or the invocation of the contingency portion of

Alternative 2 which calls for pumping and treating of the groundwater. In addition, no adverse cross-media impacts are expected.

20.2 Compliance with Applicable or Relevant and Appropriate Requirements

The Selected Remedy of MNA complies with all ARARs. The Chemical, Location, and Action-Specific ARARs are presented below and summarized in Table 5.

Groundwater:

- Maximum Contaminant Levels (MCLs) are promulgated under the Federal Safe Drinking Water Act, 42 U.S.C. Sect. 300ff et seq. MCLs specify safe levels for drinking water contaminants measured at the tap from public water supplies.
- Enforcement Standards (ES) are adopted under the Wisconsin State Code Section NR 140 as groundwater quality standards which the WDNR consistently applies to all facilities, practices and activities that may affect groundwater quality.
- Preventive Action Limits (PALs) are contaminant-specific limits which signify a potential groundwater contamination problem. When PALs are exceeded for any constituent measured at a groundwater monitoring point, the WDNR must take action to manage or control the contamination so that the ES is not attained.

Surface Water:

- There are no direct discharges to the Fox River, except if the contingency for activating the groundwater extraction and treatment system is invoked. Under this circumstance, the discharge from the treatment pond to the Fox River must meet the water quality-based effluent limitations recommended by the WDNR. The discharger must demonstrate the requirements of WAC NR 207.04 (1) (d). Effluent limitations were calculated for each of the constituents detected in the groundwater samples at the Site under WAC NR Ch 102, 105, 106 and 207. These values are provided in Appendix F.

Wetlands:

- There are no discharges or impacts to the adjacent wetlands under this selected remedial alternative, except in the case where the contingency for activating the groundwater extraction and treatment system is invoked. In this situation, the wetland preservation goals of WAC NR 1.95 are applicable. These values are provided in Appendix F.

20.3 Cost-Effectiveness

In EPA's judgment, the Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A

TABLE 5 – SUMMARY OF ARARS FOR REMEDIAL ALTERNATIVE 2, MASTER DISPOSAL SERVICES LANDFILL

| ARAR | REQUIREMENT/PURPOSE | ALTERNATIVE 2 |
|--|--|--|
| CHEMICAL SPECIFIC | | |
| Federal | | |
| Federal Safe Drinking Water Act Maximum Contaminant Levels (MCLs), 40 CFR Part 141 | MCLs for Public Water Supply Systems measured at the tap. | Relevant and appropriate to ground water that is or could be used for drinking water |
| State | | |
| Groundwater Quality, WAC Ch NR 140; Applicable to facility practices and activities which may affect groundwater quality | Establishes groundwater quality standards (ES and PALs) for substances detected in groundwater | Relevant and appropriate to groundwater that is or could be used for drinking water |
| WAC Ch NR 105 | Establishes surface water quality criteria and secondary values for toxic substances | Applicable to surface waters of the state |
| WAC Ch NR 809 | Establishes surface water quality criteria and secondary values for toxic substances | Applicable to facility practices and activities which may affect groundwater quality |
| LOCATION SPECIFIC | | |
| Federal | | |
| Executive Order Protecting Wetlands, Executive Order 11990, Section 2, 40 CFR 6 302 (a) | Requires federal agencies to minimize the destruction, loss, or degradation of wetlands | Relevant and appropriate to remediation activities taking place in and around wetlands |
| Statement of Procedures on Floodplain Management and Wetlands Protection, 40 CFR Part 6, Appendix A | Procedures for USEPA to avoid impacts associated with the destruction of wetlands and the occupancy and modification of floodplains and wetlands | Relevant and appropriate to remediation activities taking place in and around wetlands and within floodplain |
| State | | |
| WAC Ch NR 103 (Could also be chemical specific) | Established water quality standards for wetlands | Applicable to all determinations that affect wetlands |
| WAC Ch NR 140.22(3)(d), Establishment of a Design Management Zone (DMZ). | Groundwater contaminants must not exceed target cleanup levels beyond 300 feet of the landfill boundary | Applicable to hazardous waste disposal facilities, waste piles, landfills and surface impoundments subject to regulation under NR 665.0090 to 665.0094 |

| ARAR | REQUIREMENT/PURPOSE | ALTERNATIVE 2 |
|---|---|--|
| ACTION SPECIFIC | | |
| State | | |
| WAC Ch NR 141, Groundwater Monitoring Well Requirements | Provides standards for design, construction, installation, abandonment, and documentation of groundwater monitoring wells | Applicable to modifications and maintenance of the monitoring well network |

remedy shall be cost-effective if its costs are proportional to its overall effectiveness.” (NCP §300.430(f)(1)(ii)(D)). This was accomplished by evaluating the “overall effectiveness” of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence this alternative represents a reasonable value for the money to be spent. The estimated present worth cost of the Selected Remedy is \$261,000 - \$335,000.

20.4 Utilization of Permanent Solutions and Alternative Treatment and Resource Recovery Technologies to the Maximum Extent Practicable

EPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the Selected Remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against off-site treatment and disposal as well as considering State and community acceptance. The Selected Remedy treats the residual contaminants at the Site, achieving reductions in benzene concentrations in ground water. The Selected Remedy does not present short-term risks different from the other treatment alternatives, and there are no implementability issues.

20.5 Five-Year Review Requirements

This remedy is the second operable unit remedy for the Site. The first operable unit (OU1) remedy resulted in hazardous substances, pollutants or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. As a result, a statutory five-year review of the Site was initiated in 2000 and will take place every subsequent five years to ensure that the OU1 remedy is, or will be, protective of human health and the environment. The second operable unit remedy in this decision document will also be reviewed in these five-year reviews until the remedy groundwater cleanup goals are met.

21.0 Documentation of Significant Changes

The U.S. EPA has reviewed and responded to all relevant comments received from the interested parties, including those from the State and community, during the public comment period. One comment was made on the selected alternative. Based on the public comments, EPA has determined that there is no need for any significant changes to Alternative 2—MNA with contingent groundwater extraction and treatment. In the event that additional data or information during the design of the remedy reveals the need for a modification, EPA will notify the public of

any changes to the remedy presented here in this Record of Decision in accordance with applicable law, the NCP and EPA guidance.

Part III. The Responsiveness Summary

22.0 Responsiveness Summary

The purpose of the Responsiveness Summary is to provide a summary of the comments the U.S. EPA received from the public on the Proposed Plan and Administrative Record for the Master Disposal Service Landfill Site, Town of Brookfield, Wisconsin, and to present U.S. EPA's responses to the comments. This Proposed Plan was issued July 12, 2007. The public comment period for the Proposed Plan ran from July 12, 2007 through August 10, 2007.

At the invitation of the Brookfield Town Board, U.S. EPA gave a presentation of the Proposed Plan and responded to questions during an open meeting of the Brookfield Town Board on July 17, 2007 at 7 PM. Overall, there has been little public interest or concern regarding the Preferred Alternative in the Proposed Plan document. U.S. EPA received one written comment from the city of Brookfield during the comment period. The comment and U.S. EPA's response are included in the Responsiveness Summary as Appendix C of this document. There are no technical or legal issues that arose.

The Administrative Record file for the Site, located at the Brookfield Public Library, 1900 N. Calhoun Road, Brookfield, Wisconsin, and at the U.S. EPA Region 5 Records Center in Chicago, Illinois, contains all of the information and documents supporting this ROD. The Administrative Record Index (Appendix A) identifies each of the items comprising the Administrative Record upon which the selection of the Remedial Action is based.

U.S. EPA is required by law to consider and address only those comments that are pertinent and significant to the remedial action being selected. U.S. EPA is not required to address comments which pertain to the allocation of liability for the remedial action, nor potential enforcement actions to implement the remedial action, as these are independent of the selection of the remedial action and U.S. EPA's Proposed Plan.

23.0 References

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U.S. Environmental Protection Agency, September 1998. *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water, EPA/600/R-98/128.*

U.S. Environmental Protection Agency, April 1999. *Use of Monitored Natural Attenuation at Superfund and RCRA Corrective Action and Underground Storage Tank Sites, OSWER Directive 9200.4-17P.*

U.S. Environmental Protection Agency, July 1999. *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents.* EPA 540-R-98-031.

U.S. Environmental Protection Agency, September 2000. *Institutional Controls: A Site Manager's Guide to Identifying, Evaluating and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups, EPA 540-F-00-005.*

U.S. Environmental Protection Agency, April 2004. *Performance Monitoring of MNA Remedies for VOCs in Ground Water, EPA/600/R-04/027.*

U.S. Environmental Protection Agency, May 2004. *How to Evaluate Alternative Cleanup Technologies for Underground Storage Tanks; A Guide for Corrective Action Plan Reviewers, Chapter IX-Monitored Natural Attenuation, EPA 510-R-04-002.*

U.S. Environmental Protection Agency, July 12, 2007. *Proposed Plan for the Master Disposal Service Landfill Site Groundwater Operable Unit.*

Volpe National Transportation Systems Center/ U.S. Environmental Protection Agency, June 2005. *Statistical Analysis Report (Sampling Period: 10/96-2/02) for the Master Disposal Service Landfill.*

Wisconsin Department of Natural Resources, March 2003. *Guidance on Natural Attenuation for Petroleum Releases, PUB-RR-614.*

Wisconsin Department of Natural Resources, January 2007. *WDNR Administrative Code Chapter NR 140 Groundwater Quality*

FIGURES

Figure 1 - Area Map

Figure 2 - Site Map

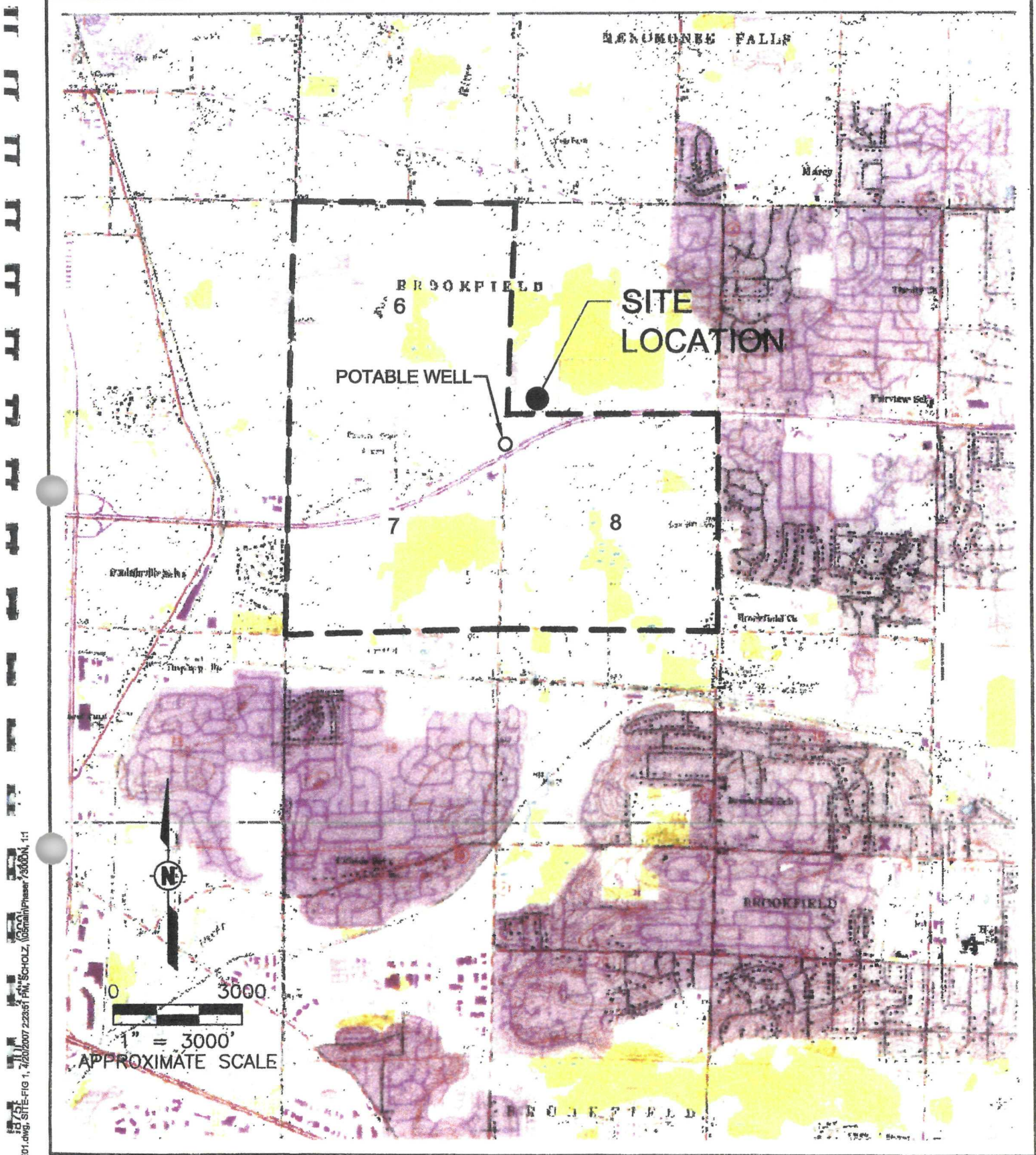
Figure 3 - Aquifer Relationships at the MDSL Site

Figure 4 –Benzene Concentration Trend at PZ-02

Figure 5 - Site Conceptual Model – Flow Chart Form

Figure 6 - Map of Residential Wells in the Site Vicinity

Figure 7 – Relationship between Landfill, Site and DMZ Boundaries

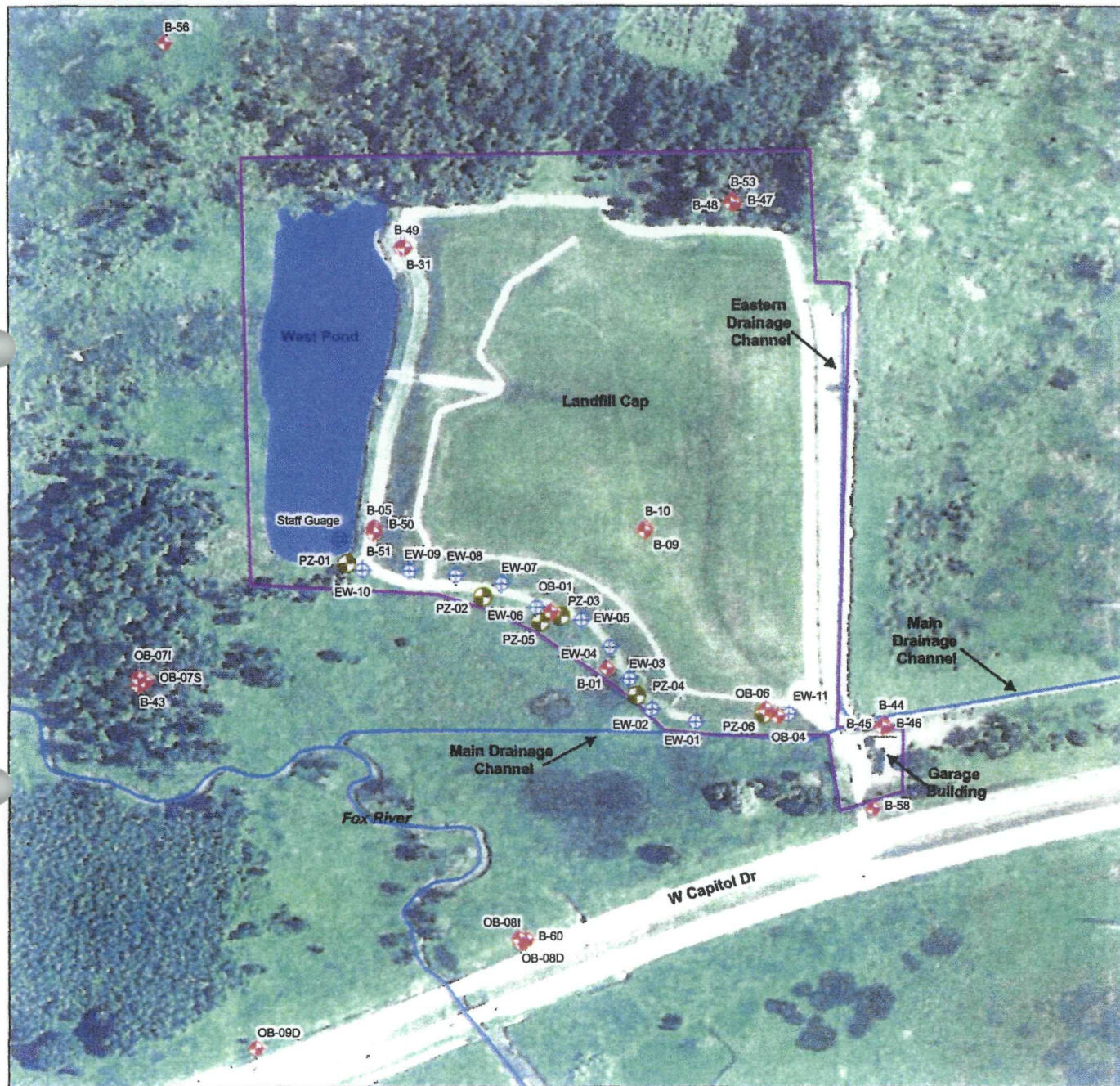


X:\Projects\87588XA\mxd\87588XA-SITE-FIG 1.dwg, SITE FIG 1, 7/20/2007 2:23:51 PM, SCHOLZ, (c:\naip\phase1\87588XA, 1:1


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 Milwaukee, WI 53224
 414-359-3030
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SITE LOCATION
MASTER DISPOSAL SERVICE LANDFILL SITE
BROOKFIELD, WISCONSIN

| | |
|----------------|---------------|
| Drawn : | CJH 8/24/2006 |
| Checked: | MMM 8/24/2006 |
| Approved: | MMM 8/24/2006 |
| PROJECT NUMBER | 87588XA |
| FIGURE NUMBER | 1 |

**Master Disposal Service Landfill
Waukesha County, WI****WID980820070****Legend**

- | | |
|-------------------------------|-----------------|
| Master Disposal Property Line | Monitoring Well |
| Water Areas | Extraction Well |
| Staff Gauge | Piezometer |

0 300 600
Feet**Figure 2**Produced by Sarah Backhouse
U.S. EPA Region 5 on 7/6/07
Image Date: 2005

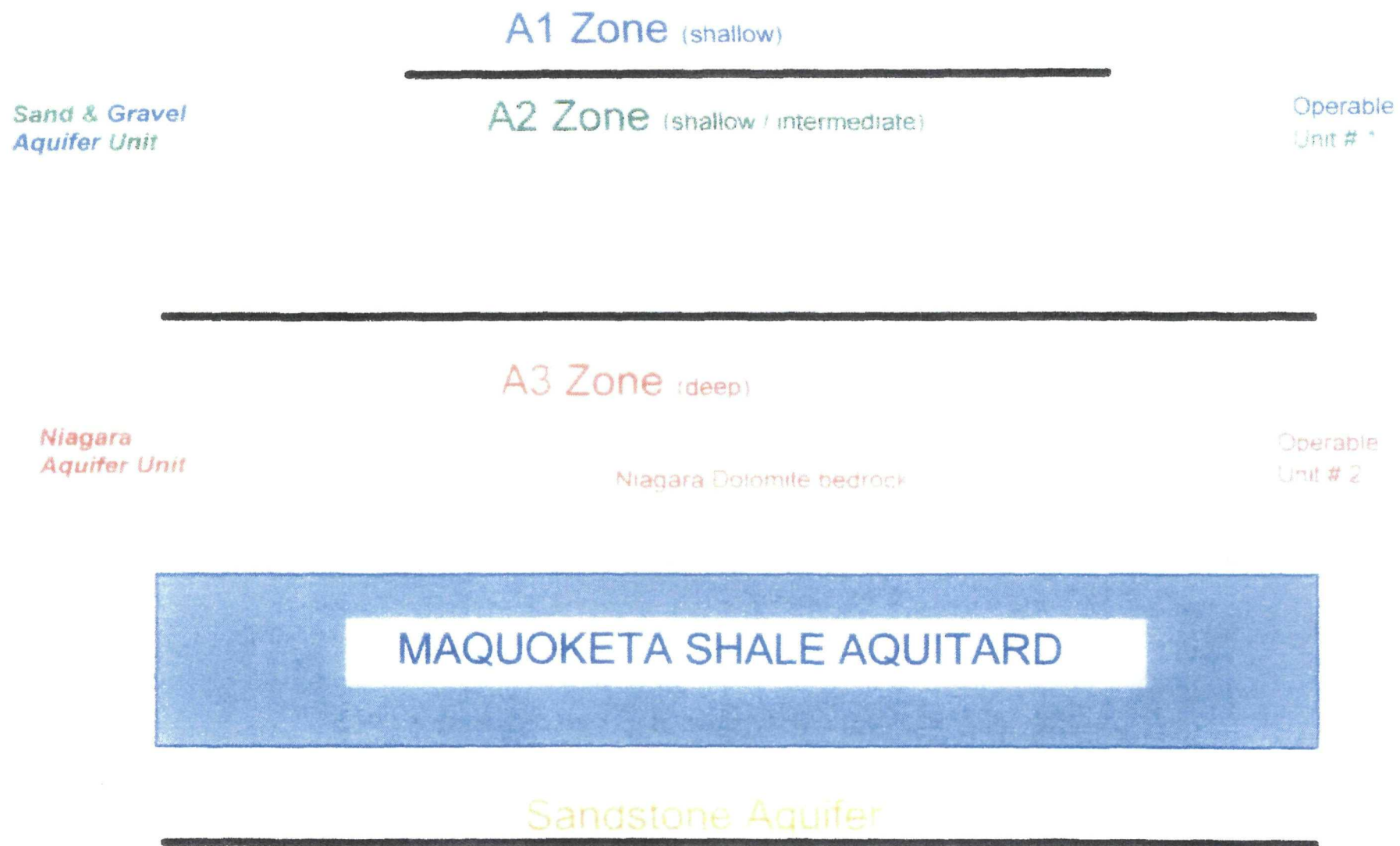


Figure 3

Figure 3 – Simplified Diagram of Groundwater Systems at the Master Disposal Service Landfill Site

Figure 4

PZ-02

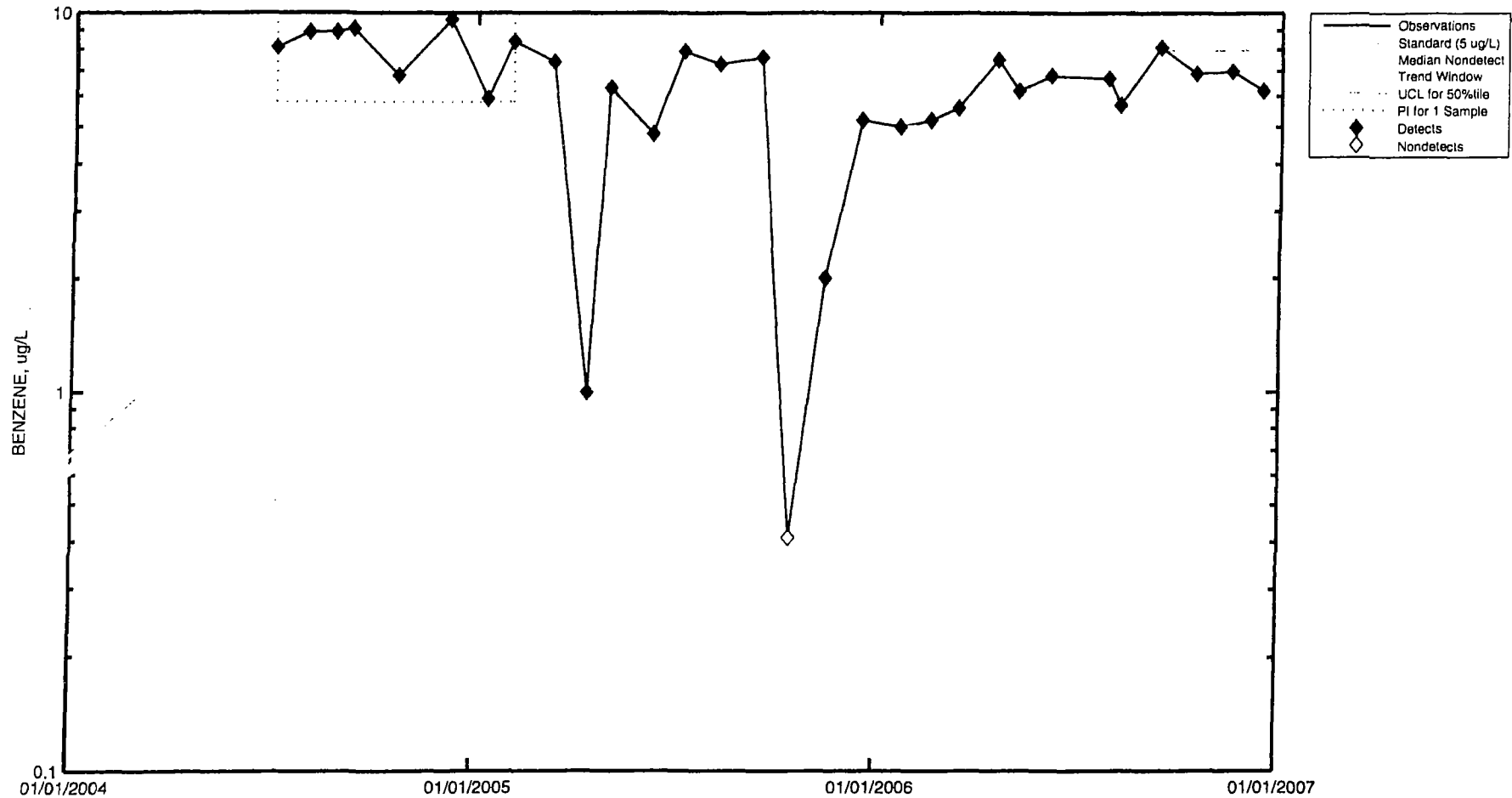
BENZENE

Master Disposal

▲ Standard

Baseline

▲ Trend



Standard Test (95%): Exceedance <UCL = 7.97e+000 ug/L>

Baseline Test (95%): No Change <UPL/LPL = 1.12e+001/5.81e+000 ug/L>

Trend Test (80%): Upward <Slope = 2.31e-001 log-ug/L/year>

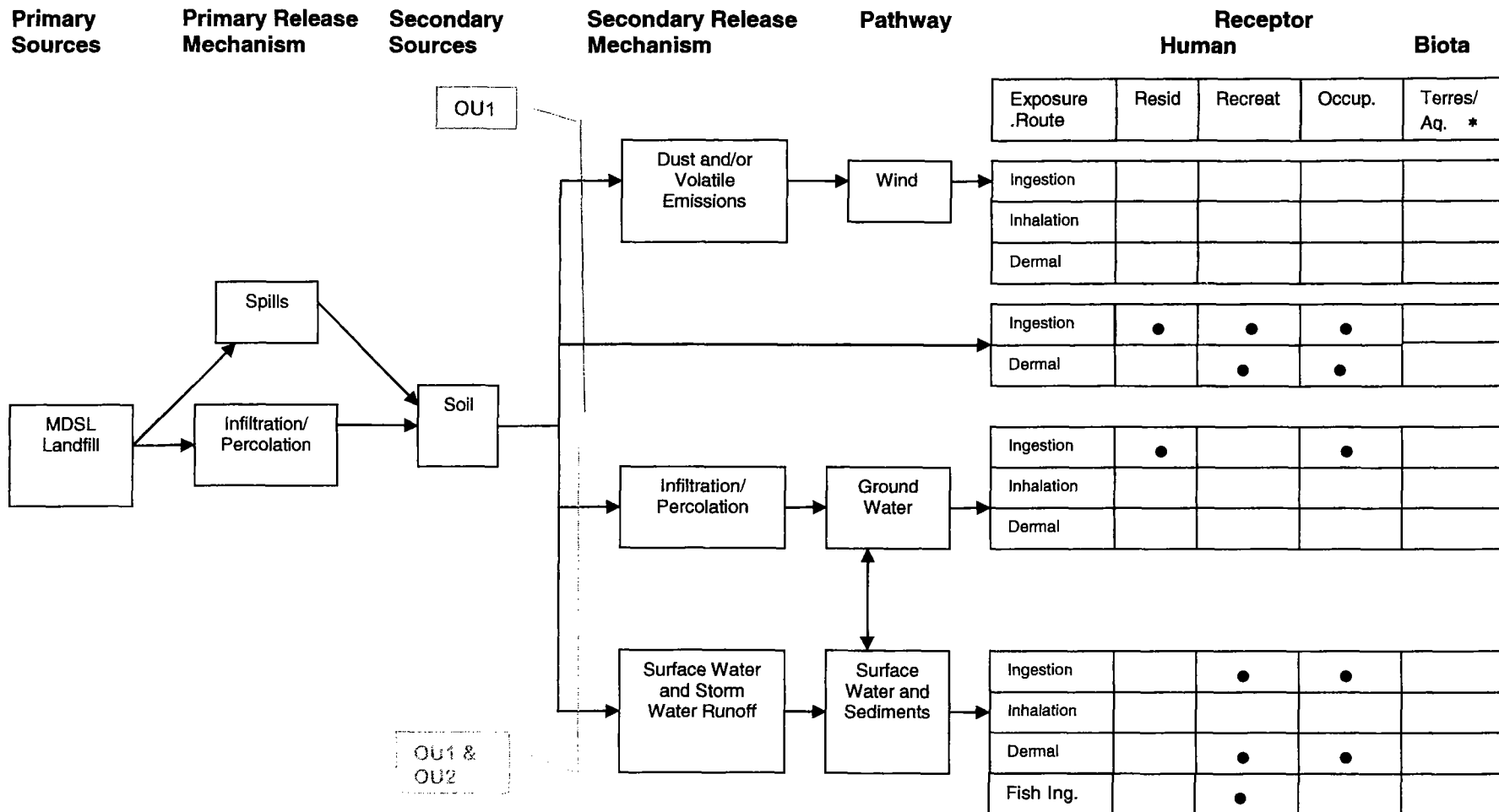
Statistical Note: ND surrogate = 0.5 X Median of nondetects' PQLs

Run Date: 24-May-2007

Prepared by: US EPA

| Master Disposal | | | | | | | | | |
|---|---------|--------|--------------------------------|----------------------------------|--|-----------------|----------------------|--|-----------------|
| Analyte Name | Well ID | Units* | Trend Test (80% Confidence) | | Compare-to-Standard Test (95% Confidence) | | | Compare-to-Baseline Test (95% Confidence) | |
| | | | Result | Slope Estimate (Units*/Yr) | Result | UCL (Units*) | Standard (Units*) | Result | UPL (Units*) |
| | | | | | | | | | |
| BENZENE | PZ-02 | ug/L | | | | | | No Change | 11.2493 |
| NOTES: # means trend coefficient of log-transformed data. Log(2) times its reciprocal is doubling(+)/halving(-) time. Statistical Note: ND surrogate = 0.5 X Median of Nondetects' PQLs. These results obtained on 05/24/2007. | | | | | | | | | |

FIGURE 5



Master Disposal Service Landfill

Conceptual Site Model

All pathways present potential exposure at the Site

•- Receptor Pathway Quantitatively Evaluated During 1989 Baseline Risk Assessment

*** Biotic Pathways Qualitatively Evaluated**



**Master Disposal Service Landfill
Waukesha County, WI**

WID980820070



Legend

- Master Disposal Service Landfill
- Residential Well Locations *

0 1,000 2,000
Feet



Produced by Sarah Backhouse
U.S. EPA Region 5 on 8/20/07
Image Date: 2005

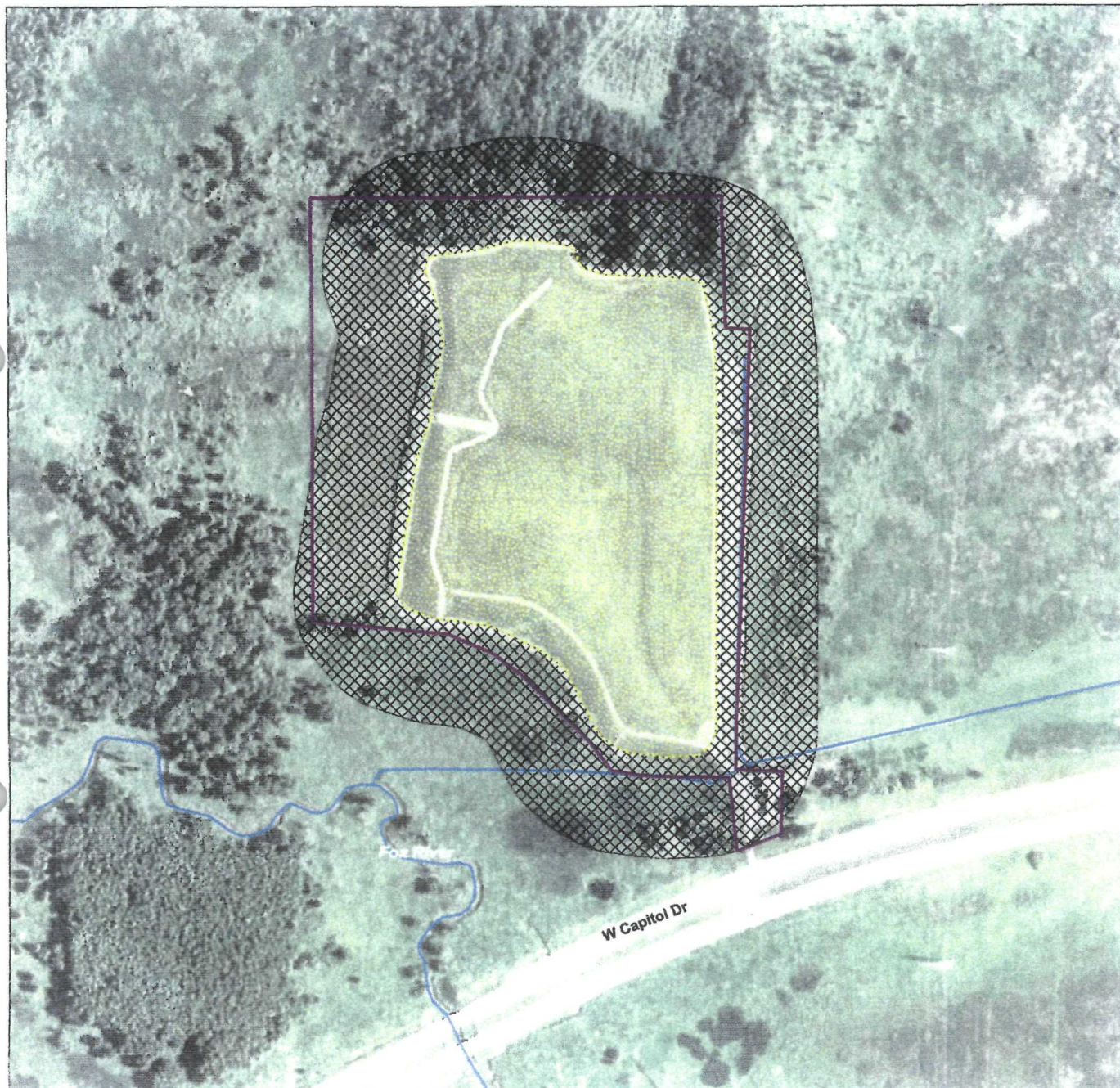
FIGURE 6

*Residential well locations are approximate. Five wells could not be located and are not depicted in the map



**Master Disposal Service Landfill
Waukesha County, WI**

WID980820070



Legend

- Master Disposal Property Line
- Landfill Area
- Design Management Zone
- Water Features

0 300 600 Feet



Produced by Sarah Backhouse
U.S. EPA Region 5 on 8/28/07
Image Date: 2005

FIGURE 7

APPENDICES

Appendix A - Administrative Record Index

Appendix B - WDNR Concurrence with the Selected Remedy

Appendix C - Responsiveness Summary

Appendix D - Site Collective Groundwater Monitoring Data

Appendix E - Mann-Kendall Spreadsheet Analysis

Appendix F - Wisconsin State Water Quality-Based Effluent Limits and Wetlands
Discharge Limits

APPENDIX A

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMOVAL ACTION

ADMINISTRATIVE RECORD
FOR
MASTER DISPOSAL SERVICE LANDFILL SITE
WAUKESHA COUNTY, WISCONSIN

UPDATE #5
JULY 12, 2007

| <u>NO.</u> | <u>DATE</u> | <u>AUTHOR</u> | <u>RECIPIENT</u> | <u>TITLE/DESCRIPTION</u> | <u>PAGES</u> |
|------------|-------------|-------------------------|-------------------------------|--|--------------|
| 1 | 07/00/96 | CH2MHILL | Master Disposal PRP Trust III | Operation and Maintenance Manual for the Master Disposal Service Landfill Site | 19 |
| 2 | 07/00/96 | CH2MHILL | Master Disposal PRP Trust III | Monitoring Plan for the Master Disposal Service Landfill Site | 176 |
| 3 | 08/00/97 | S. EPA | File | Rules of Thumb for Superfund Remedy Selection | 26 |
| 4 | 09/00/98 | U.S. EPA | File | Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water | 254 |
| 5 | 04/21/99 | U.S. EPA | File | Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action and Underground Storage Tank Sites | 41 |
| 6 | 05/00/99 | U.S. EPA | File | Fact Sheet: Monitored Natural Attenuation of Chlorinated Solvents | 1 |
| 7 | 07/26/99 | Hill, L., U.S. EPA | Jury, M., CH2MHILL | Letter re: Master Disposal Service Landfill Site is Assigned to U.S. EPA Post Construction Completion Group w/Attachment | 5 |
| 8 | 09/25/00 | U.S. EPA | U.S. EPA | Five Year Review Report for the Master Disposal Service Landfill Site | 20 |
| 9 | 09/29/00 | Fields, T., U.S. EPA | Distribution List | Memorandum re: Transmittal of Final Fact Sheet Entitled Institutional Controls: A Site Manager's Guide to Identifying, Evaluating and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups w/Attachment | 32 |

Master Disposal Service Landfill
Update #5
Page 2

| <u>NO.</u> | <u>DATE</u> | <u>AUTHOR</u> | <u>RECIPIENT</u> | <u>TITLE/DESCRIPTION</u> | <u>PAGES</u> |
|------------|-------------|---|--|--|--------------|
| 10 | 10/00/01 | WDNR | File | Fact Sheet: What Landowners Should Know: Information About Using Natural Attenuation to Clean Up Contaminated Ground-water | 4 |
| 11 | 03/00/03 | WDNR | File | Guidance on Natural Attenuation for Petroleum Releases | 106 |
| 12 | 03/30/04 | Schneider, R. & N. Peterson, Quarles & Brady, LLP | Hill, L., U.S. EPA & T. Wentland, WDNR | Letter re: MDSL PRP Group Requests Approval of change of Consultant w/Attachments | 8 |
| 13 | 04/00/04 | U.S. EPA | File | Performance Monitoring of MNA Remedies for VOCs in Ground Water | 92 |
| 14 | 05/07/04 | Mejac, M. & J. Tarvin, STS Consultants | Hill, L., U.S. EPA | Letter re: Requested Modifications to the Ground-water Extraction Program at the Master Disposal Service Site | 9 |
| 15 | 05/27/04 | Mejac, M., STS Consultants, LTD | Hill, L. U.S. EPA | E-mail Transmission re: June 2004 Groundwater Monitoring Event at the Master Disposal Service Landfill Site | 1 |
| 16 | 06/03/04 | Hill, L., U.S. EPA | Mejac, M., STS Consultants, LTD | Letter re: Response to April 26, 2004 Teleconference and STS Consultants Letter Dated May 7, 2004 | 1 |
| 17 | 07/20/04 | Mejac, M. & J. Tarvin, STS Consultants, LTD | Hill, L., U.S. EPA | Letter re: Results of June 2004 Supplementary Ground-water Monitoring Event at the Master Disposal Service Landfill Site w/Attachments | 22 |
| 18 | 08/23/04 | Mejac, M. & J. Tarvin, STS Consultants, LTD | Hill, L., U.S. EPA | Letter re: Requested Modification to Project Analytical Services for the Former Master Disposal Service Landfill Site w/Attachments | 5 |
| 19 | 03/31/05 | Mejac, M. & J. Tarvin, STS Consultants, LTD | Kujawa, J., U.S. EPA & Meyer, J., WDNR | 2004 Annual (No. 9) Monitoring Report for the Master Disposal Service Landfill Site w/Cover Letter | 186 |

| <u>NO.</u> | <u>DATE</u> | <u>AUTHOR</u> | <u>RECIPIENT</u> | <u>TITLE/DESCRIPTION</u> | <u>PAGES</u> |
|------------|-------------|---|--|---|--------------|
| 20 | 05/06/05 | STS Consultants, LTD | U.S. EPA | Technical Justification and Request for a Permanent Shutdown of Groundwater Ex- traction System and Ground- water Monitoring Plan Modi- fications at the Master Disposal Service Landfill Site | 45 |
| 21 | 06/00/05 | Volpe National Transportation Systems Center | U.S. EPA | Statistical Analysis Re- port (Sampling Period: 10/96-2/02) for the Master Disposal Service Landfill | 43 |
| 22 | 07/01/05 | Sullivan, S., U.S. EPA | Mejac, M., STS Con- sultants, LTD | Letter re: Institutional Controls Investigation Study at the Master Disposal Ser- vice Landfill Site | 5 |
| 23 | 09/23/05 | Sullivan, S., U.S. EPA | U.S. EPA | Second Five-Year Review Re- port for the Master Disposal Service Landfill Site | 168 |
| 24 | 12/01/05 | Sullivan, S., U.S. EPA | Mejac, M., STS Con- sultants, LTD | Letter re: September 2005 Five-Year Review Report for the Master Disposal Service Landfill Site | 3 |
| 25 | 03/28/06 | Mejac, M. & J. Tarvin, STS Con- sultants, LTD | Kujawa, J., U.S. EPA & J. Meyer, WDNR | 2005 Annual (No. 10) Moni- toring Report for the Master Disposal Service Landfill Site w/Cover Letter | 120 |
| 26 | 11/21/06 | Mejac, M. & J. Tarvin, STS Con- sultants, LTD | Sullivan, S., U.S. EPA | Letter re: Requested Infor- mation as a Follow-up to the September 2005 Five-Year Review Report for the Master Disposal Service Landfill Site w/Attachments | 10 |
| 27 | 01/00/07 | WDNR | U.S. EPA | WDNR Administrative Code Chapter NR 140 Groundwater Quality | 16 |
| 28 | 01/30/07 | Quarles & Brady, LLP | U.S. EPA | Annual Court Reports as Re- quired by Paragraph 30 of the Consent Decree for the Master Disposal Service Landfill Site (January 30, 1999 through January 30, 2007) | 26 |

Master Disposal Service Landfill
Update #5
Page 4

| <u>NO.</u> | <u>DATE</u> | <u>AUTHOR</u> | <u>RECIPIENT</u> | <u>TITLE/DESCRIPTION</u> | <u>PAGES</u> |
|------------|-------------|---|--|--|--------------|
| 29 | 03/29/07 | Mejac, M. & J. Tarvin, STS Con- sultants, LTD | Kujawa, J., U.S. EPA & M. Lutz WDNR | 2006 Annual (No. 11) Moni- toring Report for the Master Disposal Service Landfill Site w/Cover Letter | 145 |
| 30 | 05/17/07 | STS Consultants, LTD | U.S. EPA | Technical Memorandum for the Final Groundwater Re- medy, Operable Unit 2 for the Master Disposal Service Landfill Site | 151 |
| 31 | 07/10/07 | Sullivan, S., U.S. EPA | Mejac, M., STS Con- sultants, LTD | Letter re: U.S. EPA's Re- sponse to May 17, 2007 Technical Memorandum for Operable Unit #2 w/Attachment | 10 |
| 32 | 07/10/07 | Wentland, T., WDNR | Sullivan, S., U.S. EPA | E-mail Transmission re: Transmittal of WDNR Proposed Plan Concurrence Letter | 2 |
| 33 | 07/12/07 | U.S. EPA | Public | Proposed Plan for the Master Disposal Service Landfill Site Groundwater Operable Unit | 32 |

APPENDIX B



State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

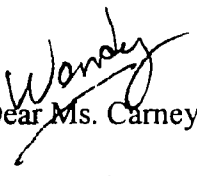
Jim Doyle, Governor
Matthew J. Frank, Secretary

101 S. Webster St.
Box 7921
Madison, Wisconsin 53707-7921
Telephone 608-265-2621
FAX 608-267-3579
TTY Access via relay - 711

September 7, 2007

Ms. Wendy Carney
U.S. EPA REGION 5
77 West Jackson Boulevard
Mail Code: SR-6J
Chicago, IL 60604-3507

Subject: Concurrence with the Record of Decision for the Groundwater Control Operable Unit, Master Disposal Service Landfill.


Dear Ms. Carney:

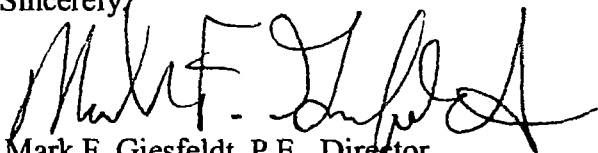
I am sending you this letter to document that the Wisconsin Department of Natural Resources has reviewed the Record of Decision for the Master Disposal Service Landfill, Operable Unit (OU-2). We have concluded that we can concur with the selected remedy, Natural Attenuation with groundwater extraction and treatment, if groundwater standards are exceeded.

It is our understanding that the selected remedy consists of the following major components:

1. The groundwater would be allowed to clean itself up through monitored natural attenuation (MNA). A critical component of natural attenuation is the monitoring of groundwater at certain locations at the Site boundary and downgradient of the landfill to ensure that contaminants do not move off-site via the groundwater.
2. Groundwater cleanup levels consistent with state and federal ARARs will also be established. Compliance with the chemical-specific groundwater cleanup levels in groundwater is determined beyond the edge of the Site boundary but within the DMZ of the landfill; these levels do not have to be met throughout the landfill.
3. This remedy includes the contingency that if monitoring indicates a potential failure of the Selected Remedy such that a predetermined trigger level is exceeded for benzene or other contaminants at the edge of the landfill, a localized portion of the on-site groundwater extraction system will be reactivated to contain the contaminated groundwater on site.

We are hopeful that your staff will continue to work in close consultation with our staff during the implementation of the Record of Decision. We appreciate your efforts thus far and look forward to working with you and your staff until the site is remediated. If you have any questions regarding this letter please contact Jim Schmidt at 414-263-8561.

Sincerely

A handwritten signature in black ink, appearing to read 'Mark F. Giesfeldt', written in a cursive style.

Mark F. Giesfeldt, P.E., Director
Bureau for Remediation and Redevelopment

c: Jim Schmidt - SER

APPENDIX C

APPENDIX C

THE RESPONSIVENESS SUMMARY

The city of Brookfield was the only comment received during the public comment period. The comment has been paraphrased below.

Comment:

The city of Brookfield Public Works Department expressed concern over the proposed implementation of Alternative 2 at the Master Disposal Services Landfill (MDSL) Site as it felt this alternative may not be protective of the groundwater. The city has been searching for new well sites to supplement the existing groundwater supply. Its newest well (Well 30) taps the dolomite aquifer; is located about 4,900 feet southeast of the landfill; and is sited in a bedrock fracture system that extends northwest towards the landfill. To date, site-related contaminants have not been detected in Well 30.

The city stated that the overall flow within the A2 and A3 zones is not likely to be south-southwest as stated in the Proposed Plan but more likely east-southeast. It also indicated that the dolomite aquifer flow is chiefly along vertical fractures and enlarged, open bedding planes. Brookfield Well 30 was sited on a fracture zone and its capacity is approximately 700 gpm. The water pumped from Well 30 is drawn in via the open fracture system. Test pumping indicated that the cone of depression around Well 30 is very asymmetrical due to fracture flow. Wells that intersected the same fracture system, or a hydraulically connected fracture system showed much more drawdown during pumping than wells not intersecting connected fractures, indicating that distance from the pumping well is not a reliable indicator of whether or not a particular well or area will be in the recharge area of a pumping well.

The city also expressed concern that groundwater flow models cannot accurately predict drawdown and recharge areas around a high-capacity municipal well screened in the fractured dolomite aquifer. The city believes that an insufficient number of monitoring wells are sited in the dolomite aquifer at the MDSL Site; hence, these wells may not accurately represent groundwater flow near the landfill, which is along preferential flow paths or fractures.

The city expressed its intention to site new municipal wells, but has limited options in either the sand and gravel aquifer or the dolomite aquifer. It recently identified more potential sites within a mile of the MDSL Site but does not want to forgo these sources due to fear of potential contamination from the Site.

Response:

The groundwater monitoring data provided from 1997 to the present for the MDSL Site clearly demonstrates that monitored natural attenuation (MNA) is breaking down the contaminants in the groundwater, resulting in a reduction of toxicity and volume of contamination. All of the groundwater concentrations for the site-related organic chemicals of concern have been reduced to non-detectable levels except for benzene. Benzene levels ranging from non-detectable levels

to 9.6 ug/L are currently within the same order of magnitude as the groundwater cleanup criteria established by this ROD at 5 ug/L for benzene; hence, EPA believes that MN.⁴ will achieve the same beneficial result that an engineered treatment system would provide. Additionally, the predicted cleanup time frames for each of the alternatives considered are about the same-- five years or less. EPA believes that this remedy will be protective of the groundwater resources in this area because benzene has not been detected in the A3 zone wells, which represent the dolomite aquifer. Further, the contingency portion of this remedy requires the settling parties conducting this remedy to demonstrate that the contaminants have not migrated beyond the Design Management Zone (DMZ) of the landfill in all three aquifer zones-- the sand and gravel and dolomite aquifers. There are currently seven monitoring wells which surround the landfill that are screened in the dolomite aquifer. These wells are downgradient to the southeast and southwest of the Site. While EPA does not dispute that the presence of faults and bedding planes contributes largely to the permeability of the Niagara Aquifer, it believes that the remedy, through the groundwater monitoring program, will employ adequate safeguards To protect the water supply of the city of Brookfield, the town of Brookfield, and all private water supplies.

APPENDIX D

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
Master Disposal Service Landfill

| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|---|-------------------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| Sand and Gravel Aquifer Unit (A1 and A2 Zones) | | | | | | | | |
| B-01 | Benzene | 9 of 11 | 11/25/1996 | 2 | 0.5 | 0 of 11 | -- | 5 |
| | | | 10/1/1997 | 1J | 0.5 | | -- | 5 |
| | | | 10/15/1998 | 2 | 0.5 | | -- | 5 |
| | | | 10/21/1999 | 1 | 0.5 | | -- | 5 |
| | | | 10/18/2000 | 2 | 0.5 | | -- | 5 |
| | | | 10/24/2001 | 1.8 | 0.5 | | -- | 5 |
| | | | 10/10/2002 | 1.1 | 0.5 | | -- | 5 |
| | | | 10/17/2005 | 1.2 | 0.5 | | -- | 5 |
| | | | 10/10/2006 | 1.3 | 0.5 | | -- | 5 |
| | Iron | 12 of 12 | 11/25/1996 | 7,510 | 150 | 12 of 12 | 7510 | 300 |
| | | | 11/25/1996 | 10,000 | 150 | | 10,000 | 300 |
| | | | 10/1/1997 | 4,900 J | 150 | | 4,900 J | 300 |
| | | | 10/21/1999 | 13,300 | 150 | | 13,300 | 300 |
| | | | 10/21/1999 | 13,100 | 150 | | 13,100 | 300 |
| | | | 10/18/2000 | 13,300 | 150 | | 13,300 | 300 |
| | | | 10/24/2001 | 10,300 | 150 | | 10,300 | 300 |
| | | | 10/10/2002 | 9,280 | 150 | | 9,280 | 300 |
| | | | 10/30/2003 | 6,570 | 150 | | 6,570 | 300 |
| | | | 10/19/2004 | 9,550 | 150 | | 9,550 | 300 |
| | | | 10/17/2005 | 11,000 | 150 | | 11,000 | 300 |
| | | | 10/10/2006 | 10,000 | 150 | | 10,000 | 300 |
| | Methylene Chlorid | 1 of 11 | 10/24/2001 | 0.62 J | 0.5 | 0 of 11 | -- | 5 |
| | Nickel | 6 of 11 | 11/25/1996 | 27.4 J | 20 | 0 of 11 | -- | 100 |
| | | | 10/1/1997 | 22.7 J | 20 | | -- | 100 |
| | | | 10/15/1998 | 35 J | 20 | | -- | 100 |
| | | | 10/21/1999 | 24 J | 20 | | -- | 100 |
| | | | 10/18/2000 | 34 | 20 | | -- | 100 |
| | | | 10/24/2001 | 22.3 J | 20 | | -- | 100 |
| | Cadmium | 1 of 10 | 10/10/2002 | 4.3 J | 0.5 | 0 of 10 | -- | 5 |
| B-05 | Arsenic | 8 of 9 | 10/2/1997 | 23.3 | 5 | 0 of 9 | -- | 50 |
| | | | 10/21/1999 | 26 | 5 | | -- | 50 |

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
Master Disposal Service Landfill

| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|------------|-----------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| | Iron | 10 of 12 | 10/20/2000 | 34.7 J | 5 | 6 of 12 | -- | 50 |
| | | | 10/24/2001 | 29.7 | 5 | | -- | 50 |
| | | | 10/8/2002 | 30.4 | 5 | | -- | 50 |
| | | | 10/30/2003 | 27.9 | 5 | | -- | 50 |
| | | | 10/18/2005 | 6 | 5 | | -- | 50 |
| | | | 10/11/2006 | 6.6 | 5 | | -- | 50 |
| | | | 11/25/1996 | 776 | 150 | | 776 | 300 |
| | | | 10/2/1997 | 7,130 J | 150 | | 7,130 J | 300 |
| | | | 10/21/1999 | 251 | 150 | | -- | 300 |
| | | | 10/21/1999 | 314 | 150 | | 314 | 300 |
| | Iron | 6 of 6 | 10/20/2000 | 327 | 150 | 5 of 6 | 327 | 300 |
| | | | 10/24/2001 | 307 | 150 | | 307 | 300 |
| | | | 10/8/2002 | 252 | 150 | | -- | 300 |
| | | | 10/30/2003 | 154 | 150 | | -- | 300 |
| | | | 10/18/2005 | 340 | 150 | | 340 | 300 |
| | | | 10/11/2006 | 160 | 150 | | -- | 300 |
| | | | 11/25/1996 | 4,640 | 150 | | 4,640 | 300 |
| | | | 11/25/1996 | 7,380 | 150 | | 7,380 | 300 |
| | | | 10/1/1997 | 7,940 J | 150 | | 7,940 J | 300 |
| | | | 10/1/1997 | 4,800 J | 150 | | 4,800 J | 300 |
| | Nickel | 3 of 3 | 10/14/1998 | 274 | 150 | 0 of 3 | -- | 300 |
| | | | 10/14/1998 | 7,510 | 150 | | 7,510 | 300 |
| | | | 11/25/1996 | 52.9 | 20 | | -- | 100 |
| | | | 10/1/1997 | 41.3 | 20 | | -- | 100 |
| | Benzene | 3 of 10 | 10/14/1998 | 50.1 | 20 | 0 of 10 | -- | 100 |
| | | | 11/25/1996 | 2 | 0.5 | | -- | 5 |
| | | | 10/1/1997 | 2 | 0.5 | | -- | 5 |
| | Iron | 15 of 15 | 10/21/1999 | 1 | 0.5 | 13 of 15 | -- | 5 |
| | | | 11/25/1996 | 2,850 | 150 | | 2,850 | 300 |
| | | | 11/25/1996 | 1,710 | 150 | | 1,710 | 300 |
| | | | 10/1/1997 | 3,440 J | 150 | | 3,440 J | 300 |

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
Master Disposal Service Landfill

| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|------------|-----------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| | | | 10/1/1997 | 31,900 J | 150 | | 31,900 J | 300 |
| | | | 10/16/1998 | 213 | 150 | | -- | 300 |
| | | | 10/16/1998 | 11,400 | 150 | | 11,400 | 300 |
| | | | 10/21/1999 | 8,870 | 150 | | 8,870 | 300 |
| | | | 10/21/1999 | 12,300 | 150 | | 12,300 | 300 |
| | | | 10/20/2000 | 3,850 | 150 | | 3,850 | 300 |
| | | | 10/25/2001 | 7,880 | 150 | | 7,880 | 300 |
| | | | 10/8/2002 | 180 | 150 | | -- | 300 |
| | | | 10/30/2003 | 5,530 | 150 | | 5,530 | 300 |
| | | | 10/18/2004 | 5,780 | 150 | | 5,780 | 300 |
| | | | 10/18/2005 | 5,800 | 150 | | 5,800 | 300 |
| | | | 10/10/2006 | 5,400 | 150 | | 5,400 | 300 |
| | | | | | | | | |
| | Lead | 2 of 10 | 11/25/1996 | 6.4 | 1.5 | 0 of 10 | -- | 15 |
| | | | 10/16/1998 | 1.6 J | 1.5 | | -- | 15 |
| B-44 | Iron | 13 of 15 | 11/25/1996 | 1,100 | 150 | 12 of 15 | 1,100 | 300 |
| | | | 10/1/1997 | 1,140 J | 150 | | 1,140 J | 300 |
| | | | 10/15/1998 | 1,070 | 150 | | 1,070 | 300 |
| | | | 10/15/1998 | 239 | 150 | | -- | 300 |
| | | | 10/19/1999 | 485 | 150 | | 485 | 300 |
| | | | 10/19/1999 | 512 | 150 | | 512 | 300 |
| | | | 10/18/2000 | 732 | 150 | | 732 | 300 |
| | | | 10/23/2001 | 606 J | 150 | | 606 J | 300 |
| | | | 10/8/2002 | 765 | 150 | | 765 | 300 |
| | | | 10/30/2003 | 1,110 | 150 | | 1,110 | 300 |
| | | | 10/20/2004 | 1,190 | 150 | | 1,190 | 300 |
| | | | 10/17/2005 | 1,300 | 150 | | 1,300 | 300 |
| | | | 10/12/2006 | 1,500 | 150 | | 1,500 | 300 |
| B-45 | Arsenic | 11 of 11 | 11/25/1996 | 8.7 J | 5 | 0 of 11 | -- | 50 |
| | | | 10/1/1997 | 9.2 J | 5 | | -- | 50 |
| | | | 10/15/1998 | 10 | 5 | | -- | 50 |
| | | | 10/19/1999 | 6.8 J | 5 | | -- | 50 |

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
Master Disposal Service Landfill

| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|------------|-----------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| | | | 10/18/2000 | 8.3 | 5 | | -- | 50 |
| | | | 10/23/2001 | 11.1 J | 5 | | -- | 50 |
| | | | 10/8/2002 | 8.7 J | 5 | | -- | 50 |
| | | | 10/30/2003 | 7.6 | 5 | | -- | 50 |
| | | | 10/20/2004 | 10.1 | 5 | | -- | 50 |
| | | | 10/17/2005 | 7.3 | 5 | | -- | 50 |
| | | | 10/12/2006 | 9.8 | 5 | | -- | 50 |
| | Iron | 3 of 14 | 11/25/1996 | 416 | 150 | 3 of 14 | 416 | 300 |
| | | | 10/1/1997 | 10,500 J | 150 | | 10,500 J | 300 |
| | | | 10/15/1998 | 683 | 150 | | 683 | 300 |
| B-47 | Iron | 14 of 15 | 11/25/1996 | 6,170 | 150 | 13 of 15 | 6,170 | 300 |
| | | | 10/2/1997 | 647 J | 150 | | 647 J | 300 |
| | | | 10/2/1997 | 5,250 J | 150 | | 5,250 J | 300 |
| | | | 10/16/1998 | 166 | 150 | | -- | 300 |
| | | | 10/16/1998 | 12,800 | 150 | | 12,800 | 300 |
| | | | 10/21/1999 | 4,170 | 150 | | 4,170 | 300 |
| | | | 10/21/1999 | 4,160 | 150 | | 4,160 | 300 |
| | | | 10/20/2000 | 4,100 | 150 | | 4,100 | 300 |
| | | | 10/30/2001 | 3,480 | 150 | | 3,480 | 300 |
| | | | 10/10/2002 | 3,450 | 150 | | 3,450 | 300 |
| | | | 10/30/2003 | 2,270 | 150 | | 2,270 | 300 |
| | | | 10/18/2004 | 4,160 | 150 | | 4,160 | 300 |
| | | | 10/18/2005 | 4,000 | 150 | | 4,000 | 300 |
| | | | 10/10/2006 | 3,600 | 150 | | 3,600 | 300 |
| B-49 | Arsenic | 10 of 11 | 11/25/1996 | 6.7 J | 5 | 0 of 11 | -- | 50 |
| | | | 10/16/1998 | 5.9 J | 5 | | -- | 50 |
| | | | 10/21/1999 | 10.1 | 5 | | -- | 50 |
| | | | 10/20/2000 | 10.7 J | 5 | | -- | 50 |
| | | | 10/25/2001 | 9.6 J | 5 | | -- | 50 |
| | | | 10/9/2002 | 13 | 5 | | -- | 50 |
| | | | 10/30/2003 | 10.2 | 5 | | -- | 50 |

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
Master Disposal Service Landfill

| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|------------|-----------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| | Iron | 12 of 15 | 10/18/2004 | 10.7 | 5 | 12 of 15 | -- | 50 |
| | | | 10/18/2005 | 11 | 5 | | -- | 50 |
| | | | 10/10/2006 | 9.4 | 5 | | -- | 50 |
| | | | 11/25/1996 | 1,510 | 150 | | 1,510 | 300 |
| | | | 10/1/1997 | 9,800 J | 150 | | 9,800 J | 300 |
| | | | 10/16/1998 | 22,500 | 150 | | 22,500 | 300 |
| | | | 10/21/1999 | 909 | 150 | | 909 | 300 |
| | | | 10/21/1999 | 894 | 150 | | 894 | 300 |
| | | | 10/20/2000 | 775 | 150 | | 775 | 300 |
| | | | 10/25/2001 | 1,020 | 150 | | 1,020 | 300 |
| | | | 10/9/2002 | 1,040 | 150 | | 1,040 | 300 |
| | | | 10/30/2003 | 1,060 | 150 | | 1,060 | 300 |
| | | | 10/18/2004 | 988 | 150 | | 988 | 300 |
| | | | 10/18/2005 | 1000 | 150 | | 1000 | 300 |
| | | | 10/10/2006 | 990 | 150 | | 990 | 300 |
| | Nickel | 6 of 11 | 10/16/1998 | 26.4 | 20 | 0 of 11 | -- | 100 |
| | | | 10/21/1999 | 26 J | 20 | | -- | 100 |
| | | | 10/25/2001 | 25.9 J | 20 | | -- | 100 |
| | | | 10/18/2004 | 28.7 | 20 | | -- | 100 |
| | | | 10/18/2005 | 24 | 20 | | -- | 100 |
| | | | 10/10/2006 | 22 | 20 | | -- | 100 |
| B-50 | Arsenic | 1 of 14 | 10/18/2005 | 5.4 | 5 | 0 of 14 | -- | 50 |
| | | | 11/25/1996 | 2,910 | 150 | | 2,910 | 300 |
| | | | 10/2/1997 | 35,400 J | 150 | | 35,400 J | 300 |
| | | | 10/15/1998 | 20,200 | 150 | | 20,200 | 300 |
| | | | 10/21/1999 | 381 | 150 | | 381 | 300 |
| | | | 10/21/1999 | 332 | 150 | | 332 | 300 |
| | | | 10/20/2000 | 390 | 150 | | 390 | 300 |
| | | | 10/24/2001 | 403 | 150 | | 403 | 300 |
| | | | 10/8/2002 | 408 | 150 | | 408 | 300 |
| | | | 10/30/2003 | 324 | 150 | | 324 | 300 |
| | | | 10/18/2005 | 250 | 150 | | -- | 300 |
| | | | 10/11/2006 | 220 | 150 | | -- | 300 |
| | Iron | 11 of 14 | 11/25/1996 | 2,910 | 150 | 9 of 14 | 2,910 | 300 |
| | | | 10/2/1997 | 35,400 J | 150 | | 35,400 J | 300 |
| | | | 10/15/1998 | 20,200 | 150 | | 20,200 | 300 |
| | | | 10/21/1999 | 381 | 150 | | 381 | 300 |
| | | | 10/21/1999 | 332 | 150 | | 332 | 300 |
| | | | 10/20/2000 | 390 | 150 | | 390 | 300 |
| | | | 10/24/2001 | 403 | 150 | | 403 | 300 |
| | | | 10/8/2002 | 408 | 150 | | 408 | 300 |
| | | | 10/30/2003 | 324 | 150 | | 324 | 300 |
| | | | 10/18/2005 | 250 | 150 | | -- | 300 |
| | | | 10/11/2006 | 220 | 150 | | -- | 300 |

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
Master Disposal Service Landfill

| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|------------|-----------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| B-53 | Arsenic | 1 of 15 | 10/18/2004 | 6.19 | 5 | 0 of 15 | -- | 50 |
| | Iron | 13 of 14 | 11/25/1996 | 2,800 | 150 | 12 of 14 | 2,800 | 300 |
| | | | 11/25/1996 | 5,610 | 150 | | 5,610 | 300 |
| | | | 10/2/1997 | 551 J | 150 | | 551 J | 300 |
| | | | 10/2/1997 | 9,960 J | 150 | | 9,960 J | 300 |
| | | | 10/16/1998 | 9,840 | 150 | | 9,840 | 300 |
| | | | 10/21/1999 | 1,940 | 150 | | 1,940 | 300 |
| | | | 10/21/1999 | 1,870 | 150 | | 1,870 | 300 |
| | | | 10/20/2000 | 269 | 150 | | -- | 300 |
| | | | 10/25/2001 | 755 | 150 | | 755 | 300 |
| | | | 10/10/2002 | 1,950 | 150 | | 1,950 | 300 |
| | | | 10/30/2003 | 3,590 | 150 | | 3,590 | 300 |
| | | | 10/18/2005 | 1,500 | 150 | | 1,500 | 300 |
| | | | 10/10/2006 | 1,000 | 150 | | 1,000 | 300 |
| B-58 | Iron | 6 of 14 | 11/25/1996 | 668 | 150 | 4 of 14 | 668 | 300 |
| | | | 10/1/1997 | 5,480 J | 150 | | 5,480 J | 300 |
| | | | 10/14/1998 | 1,020 | 150 | | 1,020 | 300 |
| | | | 10/20/1999 | 1,130 | 150 | | 1,130 | 300 |
| | | | 10/18/2005 | 240 | 150 | | -- | 300 |
| | | | 10/10/2006 | 190 | 150 | | -- | 300 |
| B-60 | Iron | 12 of 15 | 11/25/1996 | 2,320 | 150 | 12 of 15 | 2,320 | 300 |
| | | | 10/1/1997 | 3,400 J | 150 | | 3,400 J | 300 |
| | | | 10/14/1998 | 4,460 | 150 | | 4,460 | 300 |
| | | | 10/20/1999 | 1,920 | 150 | | 1,920 | 300 |
| | | | 10/20/1999 | 1,970 | 150 | | 1,970 | 300 |
| | | | 10/17/2000 | 1,440 | 150 | | 1,440 | 300 |
| | | | 10/23/2001 | 1,460 J | 150 | | 1,460 J | 300 |
| | | | 10/8/2002 | 1,800 | 150 | | 1,800 | 300 |
| | | | 10/30/2003 | 2,940 | 150 | | 2,940 | 300 |

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
Master Disposal Service Landfill

| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|------------|-----------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| | | | 10/19/2004 | 2,130 | 150 | | 2,130 | 300 |
| | | | 10/19/2005 | 2,400 | 150 | | 2,400 | 300 |
| | | | 10/11/2006 | 1,700 | 150 | | 1,700 | 300 |
| <hr/> | | | | | | | | |
| OB-07I | Iron | 27 of 33 | 10/9/1996 | 58,700 | 150 | 25 of 33 | 58,700 | 300 |
| | | | 10/9/1996 | 3,250 | 150 | | 3,250 | 300 |
| | | | 1/7/1997 | 16,300 | 150 | | 16,300 | 300 |
| | | | 4/8/1997 | 886 | 150 | | 886 | 300 |
| | | | 4/8/1997 | 21,300 | 150 | | 21,300 | 300 |
| | | | 7/9/1997 | 18,900 J | 150 | | 18,900 J | 300 |
| | | | 10/2/1997 | 181 J | 150 | | -- | 300 |
| | | | 10/2/1997 | 17,200 J | 150 | | 17,200 J | 300 |
| | | | 1/7/1998 | 13,700 | 150 | | 13,700 | 300 |
| | | | 1/7/1998 | 1,400 | 150 | | 1,400 | 300 |
| | | | 4/15/1998 | 8,450 | 150 | | 8,450 | 300 |
| | | | 4/15/1998 | 850 | 150 | | 850 | 300 |
| | | | 7/15/1998 | 69,400 | 150 | | 69,400 | 300 |
| | | | 10/14/1998 | 19,300 | 150 | | 19,300 | 300 |
| | | | 1/19/1999 | 25,500 | 150 | | 25,500 | 300 |
| | | | 4/21/1999 | 4,210 | 150 | | 4,210 | 300 |
| | | | 7/21/1999 | 2,610 | 150 | | 2,610 | 300 |
| | | | 7/21/1999 | 2,590 | 150 | | 2,590 | 300 |
| | | | 10/20/1999 | 2,620 | 150 | | 2,620 | 300 |
| | | | 10/20/1999 | 2,650 | 150 | | 2,650 | 300 |
| | | | 10/18/2000 | 2,630 | 150 | | 2,630 | 300 |
| | | | 10/24/2001 | 2,720 | 150 | | 2,720 | 300 |
| | | | 10/9/2002 | 2,830 | 150 | | 3,690 | 300 |
| | | | 10/30/2003 | 2,810 | 150 | | 2,810 | 300 |
| | | | 10/18/2004 | 2,060 | 150 | | 2,060 | 300 |
| | | | 10/18/2005 | 1,500 | 150 | | 1,500 | 300 |
| | | | 10/9/2006 | 2,000 | 150 | | 2,000 | 300 |
| | Nickel | 1 of 19 | 10/9/1996 | 78 | 20 | 0 of 19 | -- | 100 |

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
Master Disposal Service Landfill

| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|------------|-----------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| OB-07S | Arsenic | 15 of 20 | 1/7/1997 | 5.2 J | 5 | 0 of 20 | -- | 50 |
| | | | 4/8/1997 | 5.8 J | 5 | | -- | 50 |
| | | | 7/9/1997 | 6.1 J | 5 | | -- | 50 |
| | | | 10/2/1997 | 8.5 J | 5 | | -- | 50 |
| | | | 1/7/1998 | 6.9 J | 5 | | -- | 50 |
| | | | 4/15/1998 | 7.4 J | 5 | | -- | 50 |
| | | | 7/21/1999 | 11.4 | 5 | | -- | 50 |
| | | | 10/20/1999 | 16.1 | 5 | | -- | 50 |
| | | | 10/18/2000 | 13.3 | 5 | | -- | 50 |
| | | | 10/24/2001 | 11.7 | 5 | | -- | 50 |
| | | | 10/9/2002 | 15.3 | 5 | | -- | 50 |
| | | | 10/30/2003 | 11.7 | 5 | | -- | 50 |
| | | | 10/18/2004 | 9.22 | 5 | | -- | 50 |
| | | | 10/18/2005 | 8.6 | 5 | | -- | 50 |
| | | | 10/9/2006 | 6.2 | 5 | | -- | 50 |
| | Iron | 29 of 33 | 10/9/1996 | 729 | 150 | 29 of 33 | 729 | 300 |
| | | | 10/9/1996 | 92,200 | 150 | | 92,200 | 300 |
| | | | 1/7/1997 | 26,100 | 150 | | 26,100 | 300 |
| | | | 1/7/1997 | 489 | 150 | | 489 | 300 |
| | | | 4/8/1997 | 2,410 | 150 | | 2,410 | 300 |
| | | | 4/8/1997 | 15,800 | 150 | | 15,800 | 300 |
| | | | 7/9/1997 | 873 J | 150 | | 873 J | 300 |
| | | | 7/9/1997 | 7,570 J | 150 | | 7,570 J | 300 |
| | | | 10/2/1997 | 18,500 J | 150 | | 18,500 J | 300 |
| | | | 10/2/1997 | 2,500 J | 150 | | 2,500 J | 300 |
| | | | 1/7/1998 | 8,440 | 150 | | 8,440 | 300 |
| | | | 1/7/1998 | 2,660 | 150 | | 2,660 | 300 |
| | | | 4/15/1998 | 2,450 | 150 | | 2,450 | 300 |
| | | | 4/15/1998 | 7,980 | 150 | | 7,980 | 300 |
| | | | 7/15/1998 | 13,300 | 150 | | 13,300 | 300 |
| | | | 10/14/1998 | 20,800 | 150 | | 20,800 | 300 |
| | | | 1/19/1999 | 14,800 | 150 | | 14,800 | 300 |
| | | | 4/21/1999 | 4,420 | 150 | | 4,420 | 300 |
| | | | 7/21/1999 | 3,530 | 150 | | 3,530 | 300 |
| | | | 7/21/1999 | 3,510 | 150 | | 3,510 | 300 |

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
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| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|------------|-----------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| | | | 10/20/1999 | 3,890 | 150 | | 3,890 | 300 |
| | | | 10/20/1999 | 3,850 | 150 | | 3,850 | 300 |
| | | | 10/18/2000 | 3,460 | 150 | | 3,460 | 300 |
| | | | 10/24/2001 | 4,780 | 150 | | 4,780 | 300 |
| | | | 10/9/2002 | 3,690 | 150 | | 2,830 | 300 |
| | | | 10/30/2003 | 2,860 | 150 | | 2,860 | 300 |
| | | | 10/18/2004 | 2,950 | 150 | | 2,950 | 300 |
| | | | 10/18/2005 | 2,300 | 150 | | 2,300 | 300 |
| | | | 10/9/2006 | 2,200 | 150 | | 2,200 | 300 |
| | Nickel | 1 of 19 | 10/9/1996 | 165 | 20 | 1 of 19 | 165 | 100 |
| OB-08I | Iron | 23 of 33 | 10/8/1996 | 881 | 150 | 23 of 33 | 881 | 300 |
| | | | 10/8/1996 | 7,380 | 150 | | 7,380 | 300 |
| | | | 1/6/1997 | 9,000 | 150 | | 9,000 | 300 |
| | | | 4/7/1997 | 5,280 | 150 | | 5,280 | 300 |
| | | | 7/8/1997 | 6,550 J | 150 | | 6,550 J | 300 |
| | | | 10/1/1997 | 3,480 J | 150 | | 3,480 J | 300 |
| | | | 1/6/1998 | 5,340 J | 150 | | 5,340 J | 300 |
| | | | 4/14/1998 | 5,060 | 150 | | 5,060 | 300 |
| | | | 7/15/1998 | 2,740 | 150 | | 2,740 | 300 |
| | | | 10/14/1998 | 3,840 | 150 | | 3,840 | 300 |
| | | | 1/19/1999 | 4,320 | 150 | | 4,320 | 300 |
| | | | 4/21/1999 | 5,670 | 150 | | 5,670 | 300 |
| | | | 7/22/1999 | 2,330 | 150 | | 2,330 | 300 |
| | | | 7/22/1999 | 2,640 | 150 | | 2,640 | 300 |
| | | | 10/20/1999 | 2,260 | 150 | | 2,260 | 300 |
| | | | 10/20/1999 | 2,830 | 150 | | 2,830 | 300 |
| | | | 10/17/2000 | 2,910 | 150 | | 2,910 | 300 |
| | | | 10/23/2001 | 2,600 J | 150 | | 2,600 J | 300 |
| | | | 10/8/2002 | 2,580 | 150 | | 2,580 | 300 |
| | | | 10/30/2003 | 1,810 | 150 | | 1,810 | 300 |
| | | | 10/18/2004 | 1,920 | 150 | | 1,920 | 300 |
| | | | 10/19/2005 | 1,900 | 150 | | 1,900 | 300 |
| | | | 10/11/2006 | 2,000 | 150 | | 2,000 | 300 |

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
Master Disposal Service Landfill

| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|--|---------------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| | Thallium | 1 of 2 | 1/19/1999 | 0.83 J | 0.4 | 0 of 2 | -- | 2 |
| | Cadmium | 1 of 19 | 10/8/2002 | 4.6 J | 0.5 | 0 of 19 | -- | 5 |
| Niagara Dolomite Aquifer Unit (A3 Zone) | | | | | | | | |
| B-43 | Chloromethane | 1 of 10 | 10/24/2001 | 0.57 J | 0.3 | 0 of 10 | -- | 3 |
| | Iron | 13 of 15 | 11/25/1996 | 2,470 | 150 | 12 of 15 | 2,470 | 300 |
| | | | 10/2/1997 | 5,250 J | 150 | | 5,250 J | 300 |
| | | | 10/2/1997 | 281 J | 150 | | -- | 300 |
| | | | 10/14/1998 | 12,700 | 150 | | 12,700 | 300 |
| | | | 7/21/1999 | 1,580 | 150 | | 1,580 | 300 |
| | | | 10/20/1999 | 1,540 | 150 | | 1,540 | 300 |
| | | | 10/18/2000 | 1,490 | 150 | | 1,490 | 300 |
| | | | 10/24/2001 | 1,660 | 150 | | 1,660 | 300 |
| | | | 10/9/2002 | 1,790 | 150 | | 1,790 | 300 |
| | | | 10/30/2003 | 1,970 | 150 | | 1,970 | 300 |
| | | | 10/18/2004 | 1,460 | 150 | | 1,460 | 300 |
| | | | 10/18/2005 | 1,700 | 150 | | 1,700 | 300 |
| | | | 10/9/2006 | 1,200 | 150 | | 1,200 | 300 |
| | Manganese | 9 of 9 | 7/21/1999 | 43.9 | 25 | 2 of 9 | -- | 50 |
| | | | 10/20/1999 | 44.2 | 25 | | -- | 50 |
| | | | 10/18/2000 | 41.9 | 25 | | -- | 50 |
| | | | 10/24/2001 | 44.4 | 25 | | -- | 50 |
| | | | 10/9/2002 | 47.4 | 25 | | -- | 50 |
| | | | 10/30/2003 | 48.5 | 25 | | -- | 50 |
| | | | 10/18/2004 | 53.9 | 25 | | 53.9 | 50 |
| | | | 10/18/2005 | 55 | 25 | | 55 | 50 |
| | | | 10/9/2006 | 44 | 25 | | -- | 50 |
| | Antimony | 2 of 7 | 10/20/1999 | 15.4 J | 1.2 | 2 of 7 | 15.4 J | 6 |
| | | | 10/18/2000 | 14.1 | 1.2 | | 14.1 | 6 |
| B-46 | Cadmium | 1 of 19 | 7/8/1997 | 1.2 J | 0.5 | 0 of 19 | -- | 5 |
| | Chloromethane | 1 of 19 | 10/23/2001 | 1.2 J | 0.3 | 0 of 19 | -- | 3 |
| | Manganese | 15 of 20 | 10/7/1996 | 25.8 | 25 | 0 of 20 | -- | 50 |

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
Master Disposal Service Landfill

| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|------------|-----------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| | | | 1/6/1997 | 30.2 | 25 | | -- | 50 |
| | | | 4/8/1997 | 29.1 | 25 | | -- | 50 |
| | | | 7/8/1997 | 33.1 | 25 | | -- | 50 |
| | | | 10/1/1997 | 25.3 J | 25 | | -- | 50 |
| | | | 1/19/1999 | 37.8 | 25 | | -- | 50 |
| | | | 4/21/1999 | 26.1 | 25 | | -- | 50 |
| | | | 7/21/1999 | 38.5 | 25 | | -- | 50 |
| | | | 10/19/1999 | 33.9 | 25 | | -- | 50 |
| | | | 10/18/2000 | 35.3 | 25 | | -- | 50 |
| | | | 10/23/2001 | 36.3 | 25 | | -- | 50 |
| | | | 10/30/2003 | 41.7 | 25 | | -- | 50 |
| | | | 10/18/2004 | 39.6 | 25 | | -- | 50 |
| | | | 10/17/2005 | 33 | 25 | | -- | 50 |
| | | | 10/12/2006 | 31 | 25 | | -- | 50 |
| B-48 | Arsenic | 18 of 20 | 1/7/1997 | 10.2 | 5 | 0 of 20 | -- | 50 |
| | | | 4/8/1997 | 9.6 J | 5 | | -- | 50 |
| | | | 7/9/1997 | 10.8 | 5 | | -- | 50 |
| | | | 10/2/1997 | 9.9 J | 5 | | -- | 50 |
| | | | 1/6/1998 | 7.7 J | 5 | | -- | 50 |
| | | | 4/14/1998 | 10.8 | 5 | | -- | 50 |
| | | | 7/16/1998 | 10.1 | 5 | | -- | 50 |
| | | | 10/16/1998 | 9.9 J | 5 | | -- | 50 |
| | | | 1/20/1999 | 10.8 | 5 | | -- | 50 |
| | | | 4/22/1999 | 10.7 | 5 | | -- | 50 |
| | | | 7/20/1999 | 7.2 J | 5 | | -- | 50 |
| | | | 10/21/1999 | 10 J | 5 | | -- | 50 |
| | | | 10/20/2000 | 10.8 J | 5 | | -- | 50 |
| | | | 10/25/2001 | 9.1 J | 5 | | -- | 50 |
| | | | 10/30/2003 | 8.6 J | 5 | | -- | 50 |
| | | | 10/18/2004 | 8.72 | 5 | | -- | 50 |
| | | | 10/18/2005 | 8.1 | 5 | | -- | 50 |
| | | | 10/10/2006 | 8.7 | 5 | | -- | 50 |
| | Mercury | 1 of 18 | 10/20/2000 | 0.21 | 0.2 | 0 of 18 | -- | 2 |

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
Master Disposal Service Landfill

| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|------------|---------------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| | Antimony | 1 of 18 | 4/22/1999 | 12 J | 1.2 | 1 of 18 | 12 J | 6 |
| | Thallium | 1 of 18 | 10/20/2000 | 0.73 J | 0.4 | 0 of 18 | -- | 2 |
| <hr/> | | | | | | | | |
| B-51 | Cadmium | 1 of 19 | 7/9/1997 | 24.8 | 0.5 | 1 of 19 | 24.8 | 5 |
| | Chloromethane | 1 of 19 | 10/24/2001 | 1.2 J | 0.3 | 0 of 19 | -- | 3 |
| | Iron | 10 of 20 | 4/15/1998 | 161 | 150 | 5 of 20 | -- | 300 |
| | | | 7/22/1999 | 289 | 150 | | -- | 300 |
| | | | 10/21/1999 | 324 | 150 | | 324 | 300 |
| | | | 10/20/2000 | 326 | 150 | | 326 | 300 |
| | | | 10/24/2001 | 292 | 150 | | -- | 300 |
| | | | 10/9/2002 | 308 | 150 | | 308 | 300 |
| | | | 10/30/2003 | 353 | 150 | | 353 | 300 |
| | | | 10/18/2004 | 208 | 150 | | -- | 300 |
| | | | 10/18/2005 | 300 | 150 | | -- | 300 |
| | | | 10/11/2006 | 310 | 150 | | 310 | 300 |
| <hr/> | | | | | | | | |
| B-56 | Arsenic | 7 of 20 | 1/7/1997 | 5.2 J | 5 | 0 of 20 | -- | 50 |
| | | | 10/22/1999 | 6 J | 5 | | -- | 50 |
| | | | 10/17/2000 | 6.4 J | 5 | | -- | 50 |
| | | | 10/23/2001 | 6.7 J | 5 | | -- | 50 |
| | | | 10/30/2003 | 6.8 | 5 | | -- | 50 |
| | | | 10/18/2004 | 10.0 | 5 | | -- | 50 |
| | | | 10/19/2005 | 5.5 | 5 | | -- | 50 |
| | Chloromethane | 1 of 19 | 10/23/2001 | 0.67 J | 0.3 | 0 of 19 | -- | 3 |
| | Iron | 9 of 20 | 7/20/1999 | 602 | 150 | 9 of 20 | 602 | 300 |
| | | | 10/22/1999 | 700 | 150 | | 700 | 300 |
| | | | 10/17/2000 | 617 | 150 | | 617 | 300 |
| | | | 10/23/2001 | 711 J | 150 | | 711 J | 300 |
| | | | 10/10/2002 | 646 | 150 | | 646 | 300 |
| | | | 10/30/2003 | 553 | 150 | | 553 | 300 |
| | | | 10/18/2004 | 380 | 150 | | 380 | 300 |
| | | | 10/19/2005 | 560 | 150 | | 560 | 300 |
| | | | 10/9/2006 | 530 | 150 | | 530 | 300 |

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
Master Disposal Service Landfill

| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|------------|---------------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| | Antimony | 3 of 18 | 1/6/1998 | 18.8 J | 1.2 | 3 of 18 | 18.8 J | 6 |
| | | | 4/13/1998 | 14 J | 1.2 | | 14 J | 6 |
| | | | 10/14/1998 | 9.1 J | 1.2 | | 9.1 J | 6 |
| | | | 10/17/2000 | 0.72 J | 0.4 | | -- | 2 |
| | | | | | | | | |
| OB-08D | Chloromethane | 1 of 19 | 10/23/2001 | 1.4 J | 0.3 | 0 of 19 | -- | 3 |
| | Iron | 13 of 19 | 4/7/1997 | 616 | 150 | 13 of 19 | 616 | 300 |
| | | | 10/1/1997 | 394 J | 150 | | 394 J | 300 |
| | | | 1/6/1998 | 1,290 J | 150 | | 1,290 J | 300 |
| | | | 4/14/1998 | 606 | 150 | | 606 | 300 |
| | | | 7/22/1999 | 2,800 | 150 | | 2,800 | 300 |
| | | | 10/20/1999 | 2,820 | 150 | | 2,820 | 300 |
| | | | 10/17/2000 | 2,590 | 150 | | 2,590 | 300 |
| | | | 10/23/2001 | 2,730 J | 150 | | 2,730 J | 300 |
| | | | 10/9/2002 | 2,780 | 150 | | 2,780 | 300 |
| | | | 10/30/2003 | 2,090 | 150 | | 2,090 | 300 |
| | | | 10/18/2004 | 1,610 | 150 | | 1,610 | 300 |
| | | | 10/19/2005 | 2,300 | 150 | | 2,300 | 300 |
| | | | 10/11/2006 | 1,300 | 150 | | 1,300 | 300 |
| Mercury | 1 of 18 | 10/23/2001 | 11.6 | 0.2 | 1 of 18 | 11.6 | 2 | |
| Manganese | 20 of 20 | 10/8/1996 | 55.2 | 25 | 19 of 20 | 55.2 | 50 | |
| | | 1/6/1997 | 34.6 | 25 | | -- | 50 | |
| | | 4/7/1997 | 76.6 | 25 | | 76.6 | 50 | |
| | | 7/8/1997 | 70 | 25 | | 70 | 50 | |
| | | 10/1/1997 | 66.7 J | 25 | | 66.7 J | 50 | |
| | | 1/6/1998 | 67.3 | 25 | | 67.3 | 50 | |
| | | 4/14/1998 | 70.9 | 25 | | 70.9 | 50 | |
| | | 7/15/1998 | 65.3 | 25 | | 65.3 | 50 | |
| | | 10/14/1998 | 69.5 | 25 | | 69.5 | 50 | |
| | | 1/19/1999 | 78 | 25 | | 78 | 50 | |
| | | 4/21/1999 | 54.8 | 25 | | 54.8 | 50 | |
| | | 7/22/1999 | 74.1 | 25 | | 74.1 | 50 | |
| | | 10/20/1999 | 76.1 | 25 | | 76.1 | 50 | |
| | | 10/17/2000 | 73.6 | 25 | | 73.6 | 50 | |

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
Master Disposal Service Landfill

| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|------------|---------------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| | Antimony | 6 of 18 | 10/23/2001 | 76 | 25 | 6 of 18 | 76 | 50 |
| | | | 10/9/2002 | 77.1 | 25 | | 77.1 | 50 |
| | | | 10/30/2003 | 60.9 | 25 | | 60.9 | 50 |
| | | | 10/18/2004 | 188 | 25 | | 188 | 50 |
| | | | 10/19/2005 | 200 | 25 | | 200 | 50 |
| | | | 10/11/2006 | 170 | 25 | | 170 | 50 |
| | | | 10/1/1997 | 14.3 J | 1.2 | | 14.3 J | 6 |
| | | | 1/6/1998 | 18.2 J | 1.2 | | 18.2 | 6 |
| | | | 10/14/1998 | 12.5 J | 1.2 | | 12.5 J | 6 |
| | | | 7/22/1999 | 18.5 J | 1.2 | | 18.5 J | 6 |
| | | | 10/20/1999 | 12.4 J | 1.2 | | 12.4 J | 6 |
| | | | 10/23/2001 | 14.2 J | 1.2 | | 14.2 J | 6 |
| | | | Thallium | 1 of 18 | 1/19/1999 | | 0.6 J | 0.4 |
| | | | | | | | | |
| OB-09D | Chloromethane | 1 of 19 | 10/24/2001 | 0.64 J | 0.3 | 0 of 19 | -- | 3 |
| | Iron | 12 of 20 | 10/8/1996 | 164 | 150 | 9 of 20 | -- | 300 |
| | | | 4/7/1997 | 1,760 | 150 | | 1,760 | 300 |
| | | | 10/1/1997 | 627 J | 150 | | 627 J | 300 |
| | | | 1/7/1998 | 452 | 150 | | 452 | 300 |
| | | | 4/14/1998 | 1,060 | 150 | | 1,060 | 300 |
| | | | 7/22/1999 | 321 | 150 | | 321 | 300 |
| | | | 10/22/1999 | 349 | 150 | | 349 | 300 |
| | | | 10/24/2001 | 186 | 150 | | -- | 300 |
| | | | 10/9/2002 | 214 | 150 | | 214 | 300 |
| | | | 10/18/2004 | 256 | 150 | | -- | 300 |
| | | | 10/19/2005 | 510 | 150 | | 510 | 300 |
| | | | 10/10/2006 | 830 | 150 | | 830 | 300 |
| | | | | Manganese | 20 of 20 | | 10/8/1996 | 352 |
| 1/6/1997 | 288 | 25 | | | | 288 | 50 | |
| 4/7/1997 | 116 | 25 | | | | 116 | 50 | |
| 7/8/1997 | 376 | 25 | | | | 376 | 50 | |
| 10/1/1997 | 131 J | 25 | | | | 131 J | 50 | |
| 1/7/1998 | 134 | 25 | | | | 134 | 50 | |
| 4/14/1998 | 76.6 | 25 | | | | 76.6 | 50 | |

Constituents Exceeding Wisconsin Preventive Action Limits and Enforcement Standards*
Master Disposal Service Landfill

| Station Id | Parameter | Frequency of PAL Exceedance ¹ | Sample Date of PAL Exceedance | Concentration of PAL Exceedance (ug/L) ^{2,3} | PAL (ug/L) | Frequency of ES Exceedance ¹ | Concentration of ES Exceedance (ug/L) | ES (ug/L) |
|------------|-----------|--|-------------------------------|---|------------|---|---------------------------------------|-----------|
| | | | 7/15/1998 | 184 | 25 | | 184 | 50 |
| | | | 10/14/1998 | 114 | 25 | | 114 | 50 |
| | | | 1/19/1999 | 114 | 25 | | 114 | 50 |
| | | | 4/21/1999 | 63.1 | 25 | | 63.1 | 50 |
| | | | 7/22/1999 | 152 | 25 | | 152 | 50 |
| | | | 10/22/1999 | 139 | 25 | | 139 | 50 |
| | | | 10/17/2000 | 213 | 25 | | 213 | 50 |
| | | | 10/24/2001 | 191 | 25 | | 191 | 50 |
| | | | 10/9/2002 | 226 | 25 | | 226 | 50 |
| | | | 10/30/2003 | 142 | 25 | | 142 | 50 |
| | | | 10/18/2004 | 110 | 25 | | 110 | 50 |
| | | | 10/19/2005 | 200 | 25 | | 200 | 50 |
| | | | 10/10/2006 | 90 | 25 | | 90 | 50 |
| | Antimony | 2 of 18 | 10/14/1998 | 12.3 J | 1.2 | 2 of 18 | 12.3 J | 6 |
| | | | 10/24/2001 | 14.7 | 1.2 | | 14.7 J | 6 |

¹ The first number indicates the number of times a detected parameter has exceeded the PAL or ES at a well. The second number indicates the number of times a parameter has been analyzed at the well.

² Only concentrations that were detected or estimated (J) are included in the analysis.

³ Duplicate sample results were not included in the analysis.

* PAL and ES limits as established in 1990 Record of Decision

APPENDIX E

Notice: This form is the DNR supplied spreadsheet referenced in Appendices A of Comm 46 and NR 746, Wis. Adm. Code. It is provided to consultants as an optional tool for groundwater contaminant trend analysis to support site closure requests under s. Comm 46.07, Comm 46.08, NR 746.07, NR 746.08, Wis. Adm. Code. Use this form or a manual method when seeking case closure under those rules. Earlier versions of this form should not be used.

Instructions: Do not change formulas or other information in cells with a blue background, only cells with a yellow background are used for data entry. To use the spreadsheet, provide at least four rounds and not more than ten rounds of data that is not seasonally affected. Use consistent units. The spreadsheet contains several error checks, and a data entry error may cause "DATA ERR" or "DATE ERR" to be displayed. Dates that are not consecutive will show an error message and will not display the test results. The spreadsheet tests the data for both increasing and decreasing trends at both 80 percent and 90 percent confidence levels. If a declining trend is present at 80 percent but not at 90 percent, a site is still eligible for closure under Comm 46 and NR 746 provided that other conditions in those rules are met. If an increasing or decreasing trend is not present, an additional coefficient of variation test is used to test for stability, as proposed by Wiedemeier et al, 1999. For additional information, refer to the Interim Guidance on Natural Attenuation for Petroleum Releases, dated October 1999. Refer to the guidance for recommendations on data entry for non-detect values.

Site Name : Joe's Gas and Croissants, Anytown, Wisconsin

BRTS No. = 03-72-0000001

Well Number = MW-01

| Compound -> | | Benzene | Toluene | Ethylbenzene | Total Xylenes | Total TMB | MTBE |
|-------------------------------|----------------------------------|--|--|--|--|--|--|
| Event Number | Sampling Date (most recent last) | Concentration (leave blank if no data) | Concentration (leave blank if no data) | Concentration (leave blank if no data) | Concentration (leave blank if no data) | Concentration (leave blank if no data) | Concentration (leave blank if no data) |
| 1 | 10-Aug-94 | 150.00 | 38.00 | 1.30 | 4.40 | 24.50 | 55.00 |
| 2 | 3-Nov-94 | 140.00 | 18.00 | 3.00 | 17.00 | 65.00 | 2.00 |
| 3 | 17-Feb-95 | 270.00 | 16.00 | 5.30 | 11.00 | 15.70 | 2.00 |
| 4 | 18-May-95 | 740.00 | 33.00 | 8.80 | 16.00 | 28.90 | 2.00 |
| 5 | 28-Sep-95 | 290.00 | 28.00 | 3.30 | 8.20 | 16.20 | 2.00 |
| 6 | 4-Jan-96 | 92.00 | 7.80 | 1.60 | 7.50 | 5.30 | 2.00 |
| 7 | 4-Apr-96 | 25.00 | 3.60 | 0.50 | 1.00 | 2.90 | 2.00 |
| 8 | 11-Jun-96 | 890.00 | 20.00 | 8.00 | 20.00 | 57.00 | 2.00 |
| 9 | 22-Oct-96 | 450.00 | 21.00 | 12.00 | 15.00 | 33.30 | 52.00 |
| 10 | 24-Apr-97 | 480.00 | 19.00 | 6.60 | 6.70 | 18.30 | 37.00 |
| Mann Kendall Statistic (S) = | | 11.0 | -11.0 | 13.0 | -5.0 | -5.0 | 4.0 |
| Number of Rounds (n) = | | 10 | 10 | 10 | 10 | 10 | 10 |
| Average = | | 352.70 | 20.44 | 5.04 | 10.68 | 26.71 | 15.80 |
| Standard Deviation = | | 286.127 | 10.514 | 3.763 | 6.138 | 20.452 | 22.680 |
| Coefficient of Variation(CV)= | | 0.811 | 0.514 | 0.747 | 0.575 | 0.766 | 1.435 |

Error Check, Blank if No Errors Detected

| | | | | | | |
|--|------------|------------|------------|-----------------------|-----------------------|------------------------|
| Trend \geq 80% Confidence Level | INCREASING | DECREASING | INCREASING | No Trend | No Trend | No Trend |
| Trend \geq 90% Confidence Level | No Trend | No Trend | No Trend | No Trend | No Trend | No Trend |
| Stability Test, If No Trend Exists at 80% Confidence Level | NA | NA | NA | CV \leq 1 STABLE | CV \leq 1 STABLE | CV $>$ 1 NON-STABLE |

Data Entry By = A.A.

Date = 1-Feb-01

Checked By = Z.Z.

instructions

If you have opened this in Windows Notepad, select Edit=>Word Wrap to see all the text.

This zip archive file contains either the Mann-Kendall or Mann-Whitney U statistical spreadsheets in Excel 97 format and an Adobe Acrobat version of Appendix A from Comm 46 and NR 746, Wis. Adm. Code. This test is for use in conjunction with closure of petroleum contaminated sites under Comm 46.07, Comm 46.08, NR 746.07 and NR 746.08. See Appendix A, Comm 46 or NR 746, for information on the appropriate use of the statistical tests. The Natural Attenuation Guidance for Petroleum Contaminants (also referred to as the MNA Guidance) also contains a discussion of the Mann Kendall test, that document is located at: <http://www.dnr.state.wi.us/org/aw/rr/archives/pubs/RR614.pdf>

GENERAL COMMENTS ON BOTH SPREADSHEETS:

When the spreadsheets are first opened, they contain example data. The site name, DNR site number and monitoring well number should be either written over or deleted. Then, the data cells (with yellow background) should be blocked and deleted. If the block delete causes an error message, you may have inadvertently attempted to delete cells other than those listed. Only cells with a yellow background are used for data entry.

The spreadsheets are setup for up to six compounds, which is the typical number of regulated compounds of concern at most gasoline contaminated sites. The generic templates, when first loaded include the compounds that are most applicable at most gasoline sites, but different compounds may be entered instead. For example, some sites with diesel or fuel oil contamination may have several PAH compounds that warrant statistical testing. The spreadsheets can also be applied to a monitoring well with more than six compounds by using multiple spreadsheets. For example, one spreadsheet can be used for BTEX, TMB and MTBE while another spreadsheet can be set up for benzo(a)pyrene, benzo(b)fluoranthene, chrysene, etc.

The data must be entered in consistent units. Units can be ppb (ug/L), ppm (mg/L) or any other applicable units.

COPYING DATA FROM OTHER SPREADSHEETS:

Instead of hand entering the data each time the statistical spreadsheets are used, some users prefer to update and maintain a separate site data spreadsheet. They then copy data from that spreadsheet to paste into the statistical spreadsheets. When users follow that procedure, the DNR recommends that users use the "copy" function and not the "cut" function to copy data from the site data spreadsheet. If data is "cut" and pasted, there is a high probability that the formulae will be corrupted, whereas the "copy" function is much less likely to cause inaccurate results or an error message. When "Pasting" data in Excel, please note that you may be pasting not just data, but other formulae, formats, comment, etc., from the original cells. To avoid this occurrence, use the "Paste Special" and select the button for "Values" (rather than the default "All" button). The DNR also recommends against the practice of copying (or cutting) and pasting the entire statistical spreadsheet into other worksheets or workbooks, as there also is a high probability that the formulae will be corrupted and provide incorrect results.

Note that DNR recommendations for non-detect data (discussed below) differ for the Mann Kendall and the Mann Whitney U spreadsheets. Thus, hand modification of the data is still necessary when a separate site data spreadsheet is maintained.

instructions

NONDETECT VALUES:

Mann Kendall: To avoid biasing the Mann-Kendall test, the same value for all ND results must be entered in the spreadsheet for a given compound. This is to make sure that any identified trends are data trends and not trends of laboratory detection limits. The Department recommends that the value that is entered for ND results be one half of the detection limit from the round with the lowest detection limit for that compound. For example, if the results for MTBE were <2, <2, <4 and <4 ug/L, enter 1.0, 1.0, 1.0 and 1.0 into the spreadsheet instead of 1.0, 1.0, 2.0 and 2.0. This recommendation is specific to the Mann Kendall test and does not apply to other statistical procedures. Mann Whitney U: Use zeros for non-detect values. This recommendation is specific to the Mann Whitney U test ONLY and does not apply to other statistical procedures.

CHANGES FROM THE PREVIOUS VERSION:

The current version is identified by the revision date (2/2001) in the upper right hand corner on the screen. The previous version had a revision date of (5/2000) in the upper right hand corner.

Changes in Both Spreadsheets:

Hidden Cells: All cells, rows and columns are unhidden. Several consultants were concerned that they could not "see" what was going on and formulae were not available for inspection. Now contents of a cell can be inspected by placing the cursor on that cell. Error Messages: There is a section below the data entry screen that describes data entry errors in more detail and identifies which cell has that error. Thus a user can determine what and where their error is very quickly.

Unprotected Cells: There are unprotected areas built into both spreadsheets so that a user may write custom code for linking spreadsheets etc. There also is a blank unprotected worksheet included in each workbook for the same purpose.

Minor Font and Color Change: Minor changes were made to improve readability. Some text is displayed in red, such as error messages and increasing trends. Decreasing or stable trends are displayed in blue text. (Nobody has requested a black and white version, however if someone is color blind and requests a black and white version, we would make the spreadsheets available in that format.)

Increased Security: The spreadsheets were prepared to make it easier for consultants to submit data to the regulatory agencies. It therefore is critical that DNR and Commerce staff are confident that the formulae used to calculate submitted data are accurate. Unfortunately submittals have included printouts from spreadsheets that contained modified formulae, which resulted in errors. For this reason, we have increased security on the spreadsheet. Unfortunately for some users, this means that Lotus and Quattro Pro cannot open the spreadsheets. Unfortunately, this change was necessary to achieve the desired level of security.

Changes From the Previous Version of the Mann Kendall Spreadsheet:

Data Entry and Error Messages: When there are less than four rounds of data entered, instead of getting an "ERROR" message, only "n<4" is displayed. But, if text, a zero or a negative number is inadvertently

instructions
entered, the "ERROR" message is displayed. Thus, during data entry, an "ERROR" message is only displayed when there actually is an error. Note that the date must be entered before sample results collected on that date are entered to avoid an error message.

Trend Display: Instead of getting "YES" or "NO" in a specific row, the spreadsheet simply shows "Increasing" or "Decreasing" or "No Trend." Therefore, the result of the trend analysis is more obvious during data entry.

Coefficient of Variation: It was possible to inadvertently copy a zero into the Mann Kendall spreadsheet from Mann Whitney, which resulted in a coefficient of variation that was too large for the stability test to deliver correct results. The Mann Kendall spreadsheet now requires values greater than zero and will show an error message if a zero is entered.

Comparison to MNA Guidance: The algorithm shown in the MNA Guidance for calculating the Mann Kendall Statistic is also used in the spreadsheet. Therefore, a user can double check a manually calculated result against the spreadsheet.

Confidence Levels: The DNR accepts a trend analysis for declining trend at an 80 percent level of confidence, whereas many other states require a 90 percent level of confidence. Mann Kendall now displays trend results at both 80 percent and 90 percent confidence levels.

Changes From the Previous Version of the Mann Whitney U Spreadsheet:

Disk Space: A much more efficient set of formulae are used, which substantially reduces the memory requirement on the hard drive compared to the previous version. The algorithm uses the fact that the Mann-Whitney U statistic can be determined from the Wilcoxon rank-sum statistic. Note that the algorithm is different than the procedure described on New Jersey's web site, so the reference to that internet site has been removed from the instructions.

Data Entry by Copying and Pasting: The protected columns between the different compounds and the dates are no longer present, thus copying and pasting up to six compounds simultaneously along with the date is simplified.

Data Entry and Error Messages: When less than eight rounds of data are entered, if there are no text entries and no negative values, instead of getting an "ERROR" message, the user simply gets a "n<8" message. But, if text or a negative number is inadvertently entered, the "ERROR" message is displayed. Thus, during data entry, an "ERROR" message is only displayed when there actually is an error.

Aspects to Spreadsheet Design That Were Not Modified:

Look and Feel: The DNR felt that keeping the "look and feel" of the spreadsheet the same was important so that users of the previous version will not have to spend any time to figure out how the new version works.

Version of Excel: Both spreadsheets are available in a older version of Excel (Excel 97 & 95/5.0 workbook) so users that have not upgraded their software for a few years can still use the spreadsheets without having to upgrade.

Printout and Other Defaults were Not Changed: Output still prints on one page for most computer

instructions
configurations. The spreadsheet was designed at 600 by 800 pixel screen resolution making it more readable on older computer configurations. For newer systems with better resolution, simply changing the screen "zoom" level to 100 percent (or more) instead of 79 percent will improve readability.

Macros: No macros are used. Therefore, a user does not need to be concerned that enabling or using macros could transmit a virus to their computer.

APPENDIX F

Bongert / Schmidt

Attachment A

CO. RESPONSE / MEMORANDUM

STATE OF WISCONSIN

DATE: August 14, 1990

→ TO: Mark Giesfeldt - SW/3

FROM: Duane Schuettelpelz - WR/2

SUBJECT: Projected Water Quality-Based Effluent Limits for the
Master Disposal Superfund Project

AUG 22 1990
BUREAU OF SOIL -
HAZARDOUS WASTE MANAGEMENT

The purpose of this memo is to summarize the water quality-based effluent limitations recommended for the proposed direct discharge from the Master Disposal Superfund site to the Fox (Illinois) River in Waukesha County. Effluent limitations were calculated for each of the substances detected in any of the groundwater samples from the Master Disposal site. Those limitations were calculated using chapters NR 102, 105, 106 and 207 of the Wisconsin Administrative Code and are discussed below. Based on our review, the following recommendations are made on a water quality basis for a direct discharge to the Fox River:

- 1) If the discharger is able to make the necessary alternative demonstrations required in s. NR 207.04 (1)(d), the effluent limitations are as follows (based on 1/3 of the available assimilative capacity in the Fox River):

| Substance: | Daily Maximum (mg/L) | Weekly Average (mg/L) | Weekly Average (lbs/d) | Monthly Average (lbs/d) |
|----------------------------|----------------------------|-----------------------------|------------------------------|-------------------------------|
| Antimony | 13 | | | 480 |
| Arsenic | 0.73 * | | 0.045 * | |
| Cadmium | 0.22 * | | 0.0004 * | |
| Chromium (+3 or total) | 9.7 * | | 0.034 * | |
| Chromium (+6) | 0.028 * | | 0.0029 * | |
| Copper | 0.1 * | | 0.0081 * | |
| Lead | 1.5 * | | 0.0096 * | |
| Mercury | 0.0031 * | | | # |
| Nickel | 5.1 * | | 0.043 * | |
| Zinc | 0.57 * | | 0.0047 * | |
| Benzene | 22 | | | 8.5 |
| Chloroform | 29 | | | 5.3 |
| Dichlorobromomethane | | | | 5.3 |
| 1,1-Dichloroethylene | 30 | | | 2.9 |
| 1,2-Dichloroethylene | 130 | | | 920 |
| Ethylbenzene | 45 | | | 610 |
| Methylene Chloride | 220 | | | 220 |
| Toluene | 17 | | | |
| 1,1,1-Trichloroethane | 70 | | | 2000 |
| Trichloroethylene | 41 | | | 22 |
| Bis(2-ethylhexyl)Phthalate | 11 | | | |
| Aluminum | 1.5 * | | | |
| Effluent Hardness | (Monitoring only) | | | |

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RESPONSE BRANCH

2) If the discharger is not able to satisfactorily demonstrate the alternatives required in s. NR 207.04 (1)(d), the effluent limitations are as follows (based on the full available assimilative capacity in the Fox River):

| Substance: | Daily Maximum (mg/L) | Weekly Average (mg/L) | Weekly Average (lbs/d) | Monthly Average (lbs/d) |
|----------------------------|----------------------------|-----------------------------|------------------------------|-------------------------------|
| Antimony | 13 | | | 1400 |
| Arsenic | 0.73 * | | 0.14 * | |
| Cadmium | 0.22 * | | 0.0012 * | |
| Chromium (+3 or total) | 9.7 * | | 0.10 * | |
| Chromium (+6) | 0.028 * | | 0.0086 * | |
| Copper | 0.1 * | | 0.024 * | |
| Lead | 1.5 * | | 0.029 * | |
| Mercury | 0.0031 * | | | # |
| Nickel | 5.1 * | | 0.13 * | |
| Zinc | 0.57 * | | 0.014 * | |
| Benzene | 22 | | | 26 |
| Chloroform | 29 | | | 16 |
| Dichlorobromomethane | | | | 16 |
| 1,1-Dichloroethylene | 30 | | | 8.8 |
| 1,2-Dichloroethylene | 130 | | | 2700 |
| Ethylbenzene | 45 | | | 1800 |
| Methylene Chloride | 220 | | | 660 |
| Toluene | 17 | | | |
| 1,1,1-Trichloroethane | 70 | | | 6000 |
| Trichloroethylene | 41 | | | 66 |
| Bis(2-ethylhexyl)Phthalate | 11 | | | |
| Aluminum | 1.5 * | | | |
| Effluent Hardness | (Monitoring only) | | | |

* - For these substances, effluent limitations may be reported in the "total recoverable" form if such a test is reasonably available.

- For mercury, the monthly average limitation is equal to the 2 ng/L wild and domestic animal criterion because mercury was detected in background sampling of the Fox River at a concentration in excess of the criterion.

Annual maximum mass limitations based upon the recommended daily maximum limits listed above are not provided at this time because of uncertainty over the actual discharge rate.

It is recommended that the set of the above limitations which is deemed appropriate based on the s. NR 207.04 (1)(d) evaluation should be accompanied by a requirement to perform, at a minimum, monthly testing for a period of up to six months following commencement of discharge. Following the conclusion of that sampling period, effluent limitations for individual substances may be removed from the recommended list if those substances are not detected at levels of detection equal to or less than 1/5 the calculated limits for those substances. If the level of detection exceeds 1/5 of the applicable limitation or if the substance is detected in the discharge to surface water, the need for limitations and/or monitoring should be re-evaluated by this Bureau using the procedures in NR 106.

3) Whole Effluent Toxicity Testing Recommendations:

Based on the absence of biological data leading to the overall uncertainty regarding the potential for whole effluent toxicity and the proposed water quality-based chemical-specific effluent limitations derived for several toxicants identified in the contaminated groundwater, the following recommendation is provided:

Acute: Acute toxicity test batteries are recommended with three freshwater species at a frequency and duration of once each three months upon commencement of discharge for the duration of the permit.

Due to the highly contaminated nature of the wastewater from the Master Disposal Superfund Project, it is further recommended that the discharge be ceased immediately upon the failure of any one acute toxicity test battery.

Chronic: Monitoring for chronic whole effluent toxicity is not recommended at this time.

The above limitations should be compared to Best Available Technology limitations, where available, prior to final recommendation to the discharger.

Chemical-Specific Discussion:

Effluent limitations for a direct discharge to the Fox River from the Master Disposal Superfund Site were calculated for each of the substances detected in any of the groundwater monitoring wells at the Master Disposal site that have water quality criteria in ch. NR 105, Wis. Adm. Code. In addition, hardness data used in calculating water quality criteria and associated effluent limitations for metals were generated from calcium and magnesium data collected in those monitoring wells. Finally, since background information was collected in the Fox River for several of those parameters, that information was also used in the effluent limit determinations for Master Disposal. The general information used in calculating effluent limitations at this location is summarized in the following table:

EFFLUENT LIMIT CALCULATIONS FOR: Master Disposal Superfund Site
RECEIVING WATER: Fox (Illinois) River

RECEIVING WATER INFORMATION:

CLASSIFICATION: Warmwater Sport Fish, Non-Public Water Supply

RECEIVING WATER FLOWS (cfs): 7Q10 7Q2 Qave

= 0.66 1.8 34

RECEIVING WATER HARDNESS = 250 PPM

EFFLUENT INFORMATION:

EFFLUENT HARDNESS = 330 PPM

EFFLUENT DILUTION

DUE TO 21D = not available

Daily maximum effluent limitations were calculated based on twice the NR 105 (or EPA, for aluminum) acute toxicity criteria (ATC) where available, pursuant to s. NR 106.06 (2). If, for a given substance, an NR 105 criterion is not available, the daily maximum effluent limitation equals the lowest species mean LC50 value for aquatic species considered among the warmwater sportfish community subcategory, which represents the classification of the Fox River pursuant to s. NR 102.04 (3). Those limitations are summarized in the following table:

| CALCULATION OF EFFLUENT LIMITATIONS BASED ON ATC (in ug/L) | | | |
|--|------------|---------|------------------|
| SUBSTANCE | REF. HARD. | ATC | MAX. EFFL. LIMIT |
| NR 105 Criteria: | | | |
| Arsenic | | 363.8 | 727.60 |
| Cadmium | 330 | 111.31 | 222.62 |
| Chromium (+3) | 319 | 4838.65 | 9677.30 |
| Chromium (+6) | | 14.2 | 28.40 |
| Copper | 330 | 51.06 | 102.12 |
| Lead | 330 | 772.9 | 1545.80 |
| Mercury | | 1.53 | 3.06 |
| Nickel | 274 | 2528.06 | 5056.12 |
| Zinc | 330 | 283.94 | 567.88 |
| EPA Criteria: | | | |
| Aluminum | | 748 | 1496.00 |
| Limitations Based on LC50 Data (s. NR 102.04 (1)): | | | |
| Antimony | | | 13000 |
| Ethylbenzene | | | 45000 |
| Toluene | | | 17000 |
| 1,2-Dichloroethylene | | | 135000 |
| 1,1,1-Trichloroethane | | | 70000 |
| Bis(2-ethylhexyl)Phthalate | | | 11000 |
| Benzene | | | 22000 |
| Chloroform | | | 29000 |
| 1,1-Dichloroethylene | | | 30000 |
| Methylene Chloride | | | 224000 |
| Trichloroethylene | | | 41000 |

Since a specific effluent discharge rate was not proposed, the weekly and monthly average effluent limitations were calculated based on the available assimilative capacity in the Fox River which, based on the definition in s. NR 207.02 (1), is the difference between the applicable water quality criterion for a substance and the existing concentration of that substance in a surface water. The antidegradation provisions in ch. NR 207 are applicable at Master Disposal since this represents a new discharge. As a result, the assimilative capacity of the Fox River is converted from a concentration into an allowable mass loading in pounds per day using the appropriate streamflow pursuant to NR 106.

Weekly average limitations based on NR 105 chronic toxicity criteria (CTC) and monthly average limitations based on NR 105 wild and domestic animal criteria (WDAC), human threshold criteria (HTC), and human cancer criteria (HCC), are summarized in the following tables

using the full assimilative capacity of the Fox River and 1/3 of that capacity. For each of the various criteria, limitations are calculated to address two alternatives based on the implementation of NR 207. The discharger is required to make a series of demonstrations if the proposed discharge would result in a significant lowering of water quality as defined in NR 207. Those demonstrations are contained in s. NR 207.04 (1)(d) and are based on the availability of pollution control and treatment technology alternatives, including alternative discharge locations. If the discharger is able to demonstrate that there are no alternatives available that would satisfy the appropriate portions of s. NR 207.04 (1)(d), the recommended effluent limitations would be based on the full assimilative capacity of the receiving water. On the other hand, if the demonstrations in s. NR 207.04 (1)(d) show that alternatives are available, the recommended limitations would be based upon 1/3 of the available assimilative capacity in the Fox River.

Since the discharger is required to make the s. NR 207.04 (1)(d) demonstration, effluent limitations shall be recommended here based on both of the possible results of that demonstration. Therefore, two sets of weekly and monthly average limitations shall be recommended. Those alternative limitations are summarized below and on the following page.

 CALCULATION OF EFFLUENT LIMITATIONS BASED ON CTC (in ug/L)

RECEIVING WATER FLOW (cfs) = 0.165

| SUBSTANCE | REF. | CTC | MEAN | ASSIMILATIVE CAPACITY | | |
|---------------|-------|--------|-----------|-----------------------|-------------|--------------|
| | HARD. | | BACK-GRD. | FULL (ug/L) | FULL (lb/d) | x 1/3 (lb/d) |
| Arsenic | | 153 | | 153.00 | 0.13601 | 0.04533 |
| Cadmium | 250 | 1.32 | 0 | 1.32 | 0.00117 | 0.00039 |
| Chromium (+3) | 250 | 114.49 | 0 | 114.49 | 0.10177 | 0.03392 |
| Chromium (+6) | | 9.74 | 0 | 9.74 | 0.00865 | 0.00288 |
| Copper | 250 | 27.3 | 0 | 27.30 | 0.02426 | 0.00808 |
| Lead | 250 | 32.39 | 0 | 32.39 | 0.02879 | 0.00959 |
| Nickel | 250 | 143.56 | | 143.56 | 0.12761 | 0.04253 |
| Zinc | 250 | 107.8 | 92 | 15.80 | 0.01404 | 0.00468 |

 CALCULATION OF EFFLUENT LIMITATIONS BASED ON WDAC (ug/L unless shown otherwise)

RECEIVING WATER FLOW (cfs) = 1.53

| SUBSTANCE | WDAC | MEAN | ASSIMILATIVE CAPACITY | | |
|----------------|------|-----------|-----------------------|-------------|--------------|
| | | BACK-GRD. | FULL (ug/L) | FULL (lb/d) | x 1/3 (lb/d) |
| Mercury (ng/L) | 2 | 200 | 0.00 | 0 | 0 |

CALCULATION OF EFFLUENT LIMITATIONS BASED ON HTC (in ug/L)

RECEIVING WATER FLOW (cfs) = 34

| SUBSTANCE | HTC | MEAN BACK- GRD. | ASSIMILATIVE CAPACITY | | |
|----------------------------|---------|-----------------------|-----------------------|----------------|-----------------|
| | | | FULL (ug/L) | FULL (lb/d) | x 1/3 (lb/d) |
| Antimony | 7800 | | 7800 | 1429 | 476 |
| Cadmium | 82 | 0 | 82 | 15 | 5 |
| Chromium (+3) | 9500000 | 0 | 9500000 | 1740208 | 580069 |
| Chromium (+6) | 9000 | 0 | 9000 | 1649 | 550 |
| Lead | 50 | 0 | 50 | 9.16 | 3.05 |
| Mercury | 0.08 | 0.2 | 0 | 0 | 0 |
| Nickel | 460 | | 460 | 84 | 28 |
| Ethylbenzene | 10000 | | 10000 | 1832 | 611 |
| Toluene | 110000 | | 110000 | 20150 | 6717 |
| 1,2-Transdichloroethylene | 15000 | | 15000 | 2748 | 916 |
| 1,1,1-Trichloroethane | 33000 | | 33000 | 6045 | 2015 |
| Bis(2-ethylhexyl)phthalate | 30000 | | 30000 | 5495 | 1832 |

CALCULATION OF EFFLUENT LIMITATIONS BASED ON HCC (ug/L unless shown
otherwise)

RECEIVING WATER FLOW (cfs) = 34

| SUBSTANCE | HCC | MEAN BACK- GRD. | ASSIMILATIVE CAPACITY | | |
|----------------------|------|-----------------------|-----------------------|----------------|-----------------|
| | | | FULL (ug/L) | FULL (lb/d) | x 1/3 (lb/d) |
| Arsenic | 50 | | 50 | 9 | 3 |
| Benzene | 140 | | 140 | 25.65 | 8.55 |
| Chloroform | 87 | | 87 | 15.94 | 5.31 |
| Dichlorobromomethane | 87 | | 87 | 15.94 | 5.31 |
| 1,1-Dichloroethylene | 48 | | 48 | 8.79 | 2.93 |
| Methylene Chloride | 3600 | | 3600 | 659 | 220 |
| Trichloroethylene | 360 | | 360 | 66 | 22 |

It should be noted that in the above tables, there is no assimilative capacity available for mercury based on both the WDAC and HTC. No capacity is available because the background concentrations measured at Master Disposal exceeded those criteria. When existing background conditions exceed water quality criteria and the source of at least 90% of the discharge is groundwater, s. NR 106.06 (3)(e)3 states that the effluent limitation shall equal the water quality criterion. For mercury, the limit would equal the lowest criterion available, namely the 2 ng/L wild and domestic animal criterion (WDAC).

For each of the substances evaluated at Master Disposal and detected in at least one of the groundwater samples, the recommended effluent limitations (rounded) are summarized at the beginning of this memo. Where the calculated monthly average limitations exceed the weekly average limitations, only the weekly average limitations are recommended. Finally, where the acute toxicity criteria are lower than all of the remaining criteria, only a daily maximum limitation is recommended based on that acute toxicity criterion.

Wetland Discharge:

The proposed discharge also included an alternative involving discharge to a wetland along the Fox River. It is recommended that such a proposal should be discouraged because of the direct discharge alternative to the Fox River that is available. It is felt that a wetland discharge at this location would be contrary to the wetland preservation goals in s. NR 1.95, Wis. Adm. Code, especially since the proposed discharge could potentially contains high levels of heavy metals as well as persistent, bioaccumulating substances. However, since direct discharge could potentially result in dewatering of the wetland, effluent limitations shall be provided for that alternative. In this case, due to the lack of dilution in the wetland (no "upstream" flow), weekly average limitations for those substances with chronic toxicity criteria in NR 105 (CTC) shall be the same as those criteria as listed in the CTC table above, essentially resulting in application of chronic toxicity criteria at "end-of-pipe." Daily maximum limitations based on acute toxicity criteria and monthly average limitations based on the remaining criteria shall be the same as proposed above for the direct discharge to the Fox River. Although human threshold and human cancer criteria are available for waters classified for "limited aquatic life," which include wetlands at this time, those criteria are much greater than those applicable to warmwater sportfish communities. Since the waters would eventually flow into the Fox River, the uses of the Fox River must be considered as well, pursuant to s. NR 207.03 (5)(a)1. As a result, effluent limitations for discharge to the wetland tributary to the Fox River are as follows:

- 1) If the discharger is able to make the necessary alternative demonstrations required in s. NR 207.04 (1)(d), the effluent limitations are as follows (based on 1/3 of the available assimilative capacity in the Fox River):

| Substance: | Daily Maximum (mg/L) | Weekly Average (mg/L) | Weekly Average (lbs/d) | Monthly Average (lbs/d) |
|----------------------------|----------------------------|-----------------------------|------------------------------|-------------------------------|
| Antimony | 13 | | | 480 |
| Arsenic | 0.73 * | 0.15 * | | |
| Cadmium | 0.22 * | 0.0013 * | | |
| Chromium (+3 or total) | 9.7 * | 0.11 * | | |
| Chromium (+6) | 0.028 * | 0.0097 * | | |
| Copper | 0.1 * | 0.027 * | | |
| Lead | 1.5 * | 0.032 * | | |
| Mercury | 0.0031 * | | | # |
| Nickel | 5.1 * | 0.14 * | | |
| Zinc | 0.57 * | 0.11 * | | |
| Benzene | 22 | | | 8.5 |
| Chloroform | 29 | | | 5.3 |
| Dichlorobromomethane | | | | 5.3 |
| 1,1-Dichloroethylene | 30 | | | 2.9 |
| 1,2-Dichloroethylene | 130 | | | 920 |
| Ethylbenzene | 45 | | | 610 |
| Methylene Chloride | 220 | | | 220 |
| Toluene | 17 | | | |
| 1,1,1-Trichloroethane | 70 | | | 2000 |
| Trichloroethylene | 41 | | | 22 |
| Bis(2-ethylhexyl)Phthalate | 11 | | | |
| Aluminum | 1.5 * | | | |
| Effluent Hardness | (Monitoring only) | | | |

2) If the discharger is not able to satisfactorily demonstrate the alternatives required in s. NR 207.04 (1)(d), the effluent limitations are as follows (based on the full available assimilative capacity in the Fox River):

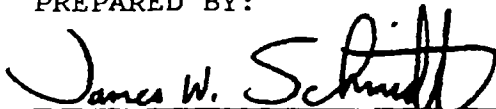
| Substance: | Daily Maximum (mg/L) | Weekly Average (mg/L) | Weekly Average (lbs/d) | Monthly Average (lbs/d) |
|----------------------------|----------------------------|-----------------------------|------------------------------|-------------------------------|
| Antimony | 13 | | | 1400 |
| Arsenic | 0.73 * | 0.15 * | | |
| Cadmium | 0.22 * | 0.0013 * | | |
| Chromium (+3 or total) | 9.7 * | 0.11 * | | |
| Chromium (+6) | 0.028 * | 0.0097 * | | |
| Copper | 0.1 * | 0.027 * | | |
| Lead | 1.5 * | 0.032 * | | |
| Mercury | 0.0031 * | | | # |
| Nickel | 5.1 * | 3.14 * | | |
| Zinc | 0.57 * | 3.11 * | | |
| Benzene | 22 | | | 26 |
| Chloroform | 29 | | | 16 |
| Dichlorobromomethane | | | | 16 |
| 1,1-Dichloroethylene | 30 | | | 8.8 |
| 1,2-Dichloroethylene | 130 | | | 2700 |
| Ethylbenzene | 45 | | | 1800 |
| Methylene Chloride | 220 | | | 660 |
| Toluene | 17 | | | |
| 1,1,1-Trichloroethane | 70 | | | 6000 |
| Trichloroethylene | 41 | | | 66 |
| Bis(2-ethylhexyl)Phthalate | 11 | | | |
| Aluminum | 1.5 * | | | |
| Effluent Hardness | (Monitoring only) | | | |

The recommendations regarding daily maximum mass limitations and monitoring frequency and the footnotes involving "total recoverable" reporting and the mercury limitation are the same as previously addressed regarding the direct discharge to the Fox River.


If there are any questions or comments, please contact Jim Schmidt (608) 267-7658 regarding chemical-specific determinations; Bob Masnado (608) 267-7662 regarding whole effluent toxicity testing; or either John Sullivan (608) 267-9753 or myself (608) 266-0156 regarding general issues.


jws/wp3/master.sf/

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